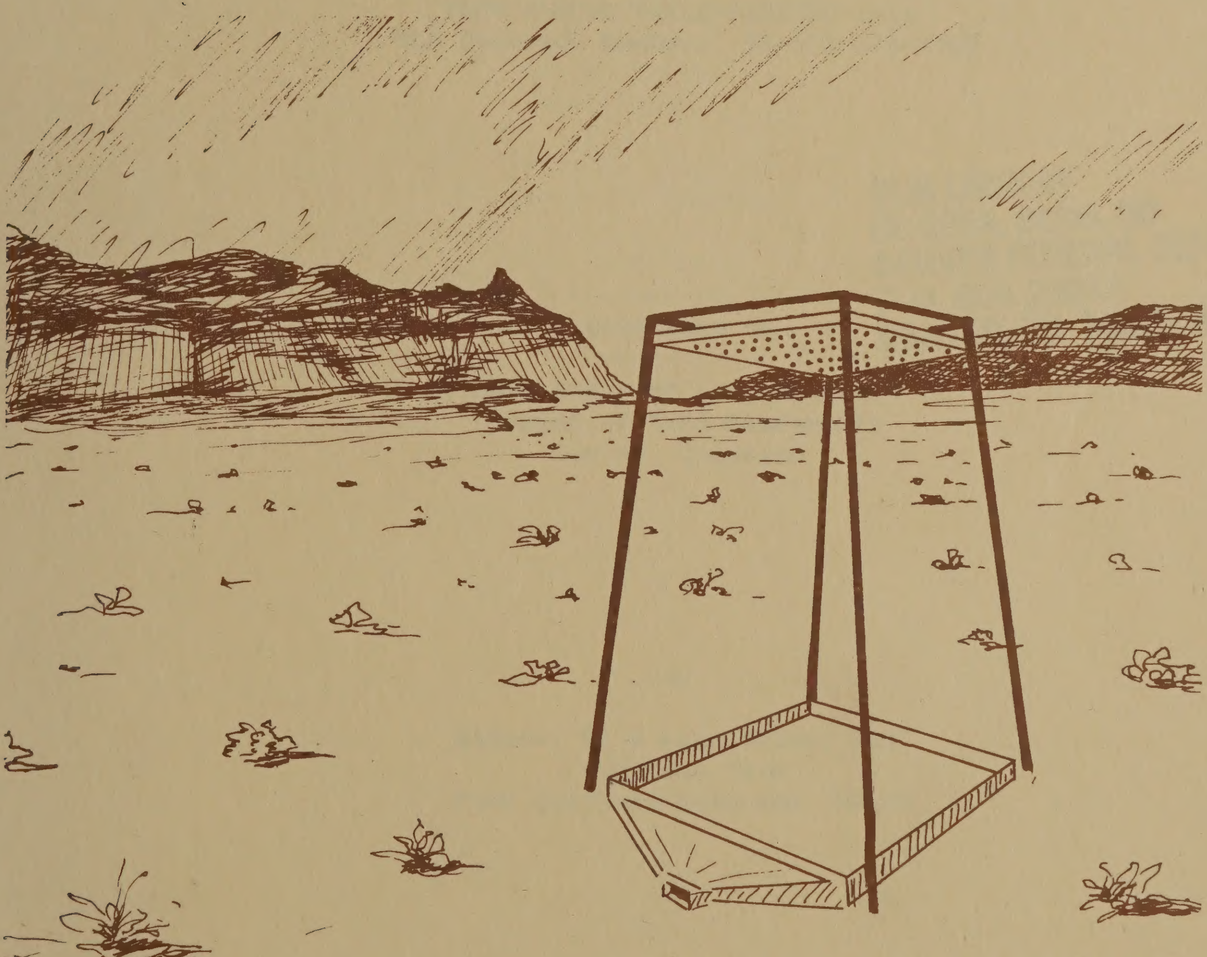
BLM LIBRARY
88018521

DEVELOPMENT OF SMALL-PLOT RAINFALL SIMULATION DEVICES TO STUDY EFFECTS OF LIVESTOCK GRAZING ON INFILTRATION RATES, RUNOFF, SEDIMENT YIELDS AND SALINITY OF SURFACE RUNOFF FROM MANCOS SHALE-DERIVED SOIL

BLM Contract Number: YA-553-CTO-1069



SEPTEMBER 1982

sla
SIMONS, LI & ASSOCIATES, INC.

21002141
ID88018521

SF
85.6
.W3
D443
1982

FINAL REPORT

DEVELOPMENT OF SMALL-PLOT RAINFALL SIMULATION DEVICES TO STUDY EFFECTS OF LIVESTOCK GRAZING ON INFILTRATION RATES, RUNOFF, SEDIMENT YIELDS AND SALINITY OF SURFACE RUNOFF FROM MANCOS SHALE-DERIVED SOIL

BLM Contract Number: YA-553-CTO-1069

BLM LIBRARY
SC-324A, BLDG. 50
DENVER FEDERAL CENTER
P. O. BOX 25047
DENVER, CO 80225-0047

Submitted to

Department of the Interior
Bureau of Land Management
Denver, Colorado

by

Simons, Li & Associates, Inc.
P.O. Box 1816
Fort Collins, Colorado 80522

September 1982

This material is based upon work supported by the Bureau of Land Management, Department of the Interior, under Contract No. YA-553-CTO-1069.

Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the Bureau of Land Management, Department of the Interior.

TABLE OF CONTENTS

Page

LIST OF TABLES vi
LIST OF PLATES viii
LIST OF FIGURES ix
CONVERSION FACTORS x
LIST OF SYMBOLS xii
ACKNOWLEDGMENTS xiv

I. INTRODUCTION

1.1 The Salinity Problem 1.1
1.2 Livestock Grazing Impacts 1.2
1.3 Project Objectives 1.3
1.4 Overview of the Scope of Work and Report Organization . 1.4

II. STUDY SITE DESCRIPTION

2.1 Local Characteristics of the Study Site 2.1
2.2 Regional Climate and Vegetation 2.1
2.3 Regional Geology and Soils 2.6
2.4 Regional Hydrology 2.11
2.5 Historical Industry and Agriculture Trends 2.11
2.6 Related Salinity Studies 2.13

III. EXPERIMENTAL DESIGN AND ESTABLISHMENT OF TEST PLOT CONDITIONS

3.1 1981 Field Season 3.1
3.2 1980 Field Season 3.1

IV. FIELD DATA COLLECTION PROCEDURES

4.1 Rainfall Simulator 4.1
4.2 Evaluation of Runoff and Water Quality Sampling Procedures 4.1
4.3 Resource Characteristics of Study Plots 4.4
4.4 Setup and Run Procedure 4.7

V. SAMPLE ANALYSIS

5.1 Sediment Analysis 5.1
5.2 Chemical Analyses 5.2

VI. TABULATION OF DATA

6.1 Field Data 6.1
6.2 Resources Characterization Data 6.2
6.3 Soil Moisture Data 6.3
6.4 Sediment Concentration Data 6.3
6.5 Chemical Data 6.3
6.6 Soil Data 6.3

TABLE OF CONTENTS (continued)

Page

VII. DATA ANALYSIS AND RESULTS

7.1 General . . . 7.1
7.2 Characteristic Statistics . . . 7.1

7.2.1 Analysis Procedure . . . 7.1
7.2.2 Results for Field Data . . . 7.2
7.2.3 Results for Resource Characterization Data . . . 7.3
7.2.4 Results for Soil Moisture Data . . . 7.3
7.2.5 Results for Sediment Concentration Data . . . 7.3
7.2.6 Results for Chemical Data . . . 7.4

7.3 Two Sample t-Test . . . 7.4

7.3.1 Analysis Procedure . . . 7.4
7.3.2 Results for Two Sample t-Tests by Replication . . . 7.5
7.3.3 Results for Two Sample t-Tests by Trampling Level . . . 7.7
7.3.4 Results for Two Sample t-Tests by Vegetation Type and Trampling Level . . . 7.15

7.4 Analysis of Variance . . . 7.15

7.4.1 Analysis Procedure . . . 7.15
7.4.2 Results of the ANOVA . . . 7.22

7.5 Correlation Analysis . . . 7.26

7.5.1 Analysis Procedure . . . 7.26
7.5.2 Results of Correlation Analysis . . . 7.26

7.6 Multiple Regression Relationship . . . 7.30

7.6.1 Analysis Procedure . . . 7.30
7.6.2 Results . . . 7.31

7.7 Evaluation of the Adequacy of Sample Sites . . . 7.32

VIII. DISCUSSION OF RESULTS

8.1 General . . . 8.1
8.2 Hypothesis Testing . . . 8.1

8.2.1 Hypothesis: The Effects of Trampling are Measurable . . . 8.1
8.2.2 Hypothesis: The Effects of Trampling on Runoff and Salt and Sediment Production Far Outweigh the Role of Plant Cover Normally Encountered on Mancos Sites, and Characterizing Selected Study Sites . . . 8.1

TABLE OF CONTENTS (continued)

Page

8.2.3 Hypothesis: The Effects of Livestock Disturbance on Runoff, and Salinity and Sediment Production Increase with Increased Percent Trampling Disturbances 8.3

8.2.4 Hypothesis: The Effects of Livestock Disturbance are Dependent Upon the Interaction of Soil Texture with Antecedent Soil Moisture Condition 8.3

8.2.5 Hypothesis: Trampling Induces Predictable Physical Changes in the Soil Water Infiltration Properties of Mancos Shale-Derived Soil 8.3

8.2.6 Hypothesis: Plot Runoff and Soil Loss Are Related 8.4

8.2.7 Hypothesis: Percent Bare Soil is a Good Predictor of Simulated Storm Runoff Peak Discharge and Volume 8.4

8.2.8 Hypothesis: Total Salt Production is Independent of the Amount of Soil Lost from a Mancos Site Plot Via Sheet and Rill Erosion . . . 8.4

8.3 Implications of Study Results on Grazing Management Policies 8.4

IX. SUMMARY AND CONCLUSION

9.1 Summary 9.1

9.2 Conclusion 9.1

X. REFERENCES 10.1

APPENDIX A REPLICATION BLOCK DIAGRAMS

APPENDIX B DATA TABLES

APPENDIX C CHARACTERISTIC STATISTICS FOR FIELD DATA

APPENDIX D CHARACTERISTIC STATISTICS FOR RESOURCE CHARACTERIZATION DATA

APPENDIX E CHARACTERISTIC STATISTICS FOR SOIL MOISTURE DATA

APPENDIX F CHARACTERISTIC STATISTICS FOR SEDIMENT CONCENTRATION DATA

TABLE OF CONTENTS (continued)

APPENDIX G CHARACTERISTIC STATISTICS FOR CHEMICAL DATA

APPENDIX H RELATIVE DISCHARGE HYDROGRAPH PLOTS

APPENDIX I INFILTRATION CURVES

APPENDIX J MULTIPLE REGRESSION CALCULATIONS

APPENDIX K TABLES FOR ANALYSIS OF VARIANCE (ANOVA)

LIST OF TABLES

Page

Table 2.1. Precipitation Amounts During the Field Season 2.4

Table 2.2. Geologic Formations or Members Contributing Salt to Lands in Eastern Utah 2.7

Table 2.3. Soil Associations Present in Castle Valley 2.9

Table 2.4. Agricultural Statistics for Emery County 2.12

Table 7.1. Two Sample Test for Means by Replication $H_o:x_1-x_2=0$ 7.6

Table 7.2. Two Sample Test for Means by Replication for Dry Runs Only - $H_o:x_1-x_2=0$ 7.8

Table 7.3. Two Sample Test for Means by Replication for Wet Runs Only - $H_o:x_1-x_2=0$ 7.9

Table 7.4. Two Sample Test for Means by Replication for Dry Runs Only - $H_o:x_1-x_2=0$ 7.10

Table 7.5. Two Sample Test for Means by Replication for Wet Runs Only - $H_o:x_1-x_2=0$ 7.11

Table 7.6. Two Sample Test for Means at Given Trampling Level $H_o:x_1-x_4=0$ 7.12

Table 7.7. Two Sample Test for Means at Given Trampling Leel $H_o:x_1-x_4=0$ 7.13

Table 7.8. Two Sample Test for Means at Given Trampling Level $H_o:x_1-x_4=0$ 7.14

Table 7.9. Two Sample Test for Means by Trampling Level with Bare Cover $H_o:x_1-x_2=0$ 7.16

Table 7.10. Two Sample Test for Means by Trampling Level with Mat Saltbush Vegetation $H_o:x_1-x_2=0$ 7.17

Table 7.11. Two Sample Test for Means by Trampling Level with Nuttall Bush Vegetation $H_o:x_1-x_2=0$ 7.18

Table 7.12. Two Sample Test for Means by Trampling Level with Bare Cover $H_o:x_1-x_2=0$ 7.19

Table 7.13. Two Sample Test for Means by Trampling Level with Mat Saltbush Vegetation $H_o:x_1-x_2=0$ 7.20

LIST OF TABLES (continued)

Page

Table 7.14. Two Sample Test for Means by Trampling Level with Nuttall Bush Vegetation $H_o:x_1-x_2=0$ 7.21

Table 7.15. Summary of ANOVA Results for All Factor Resources Characterization Data 7.23

Table 7.16. Summary of ANOVA Results for All Factor Field Data 7.24

Table 7.17. Summary of ANOVA Results for All Factor Chemical Data 7.25

Table 7.18. Correlation Coefficients for Data From Bare Plots . . . 7.27

Table 7.19. Correlation Coefficients for Data From Plots with Mat Saltbushes 7.28

Table 7.20. Correlation Coefficients for Data From Plots with Nuttall Bushes 7.29

Table 7.21. Summary of Multiple Regression Relations 7.33

Table 8.1. Estimated Accuracy of Measurements 8.2

LIST OF PLATES

Page

Plate 2.1. Study area looking northwest across Replications 7 through 10 . . . . . 2.5

Plate 4.1. Rainfall simulator and frame for wind screen 4.2

Plate 4.2. Rainfall simulator with wind screen 4.2

Plate 4.3. Wind screen surrounding rainfall simulator 4.3

Plate 4.4. Covering the bottom of the wind screen tarp with dirt for high wind conditions 4.3

Plate 4.5. Plot frame and runoff collector trough with a sample about to be taken 4.5

Plate 4.6. Measuring the EC of an aliquot of the total runoff . . 4.5

Plate 4.7. Collecting a one-liter sample for suspended sediment analysis from the total runoff 4.6

Plate 4.8. Filter apparatus used for collecting sample for chemical water quality analysis from the total runoff 4.6

Plate 4.9. Point-hit method of resource characterization 4.8

Plate 4.10. Cell count method of resource characterization 4.8

Plate 4.11. Three rainfall simulation crews operating simultaneously 4.9

Plate 4.12. Rainfall trough for verifying rainfall intensity . . . 4.9

Plate 4.13. Centering and leveling the rainfall simulator over the study plot 4.11

Plate 4.14. Hanging the wind screen tarp 4.11

Plate 4.15. Preparing to collect a volumetric sample to evaluate runoff 4.12

Plate 4.16. Evaluating the EC of the runoff sample 4.12

Plate 4.17. Measuring the volume of the sample collected for discharge evaluation 4.13

Plate 4.18. Wind screen raised to allow plot to dry to field capacity prior to wet run 4.13

LIST OF FIGURES

Page

Figure 2.1. Regions of exposed strata of Mancos formation 2.2

Figure 2.2. Study area map 2.3

Figure 2.3. Mean electrical conductivity of surface runoff for selected geologic types 2.14

Figure 3.1. Diagram of 1981 levels of treatment and replications (applied for each vegeation type) 3.2

Figure 3.2. Layout for replication blocks 3.3

Figure 3.3. Diagram of the 1980 levels of treatment and replications (applied to the zero percent vegetal cover block) 3.4

Figure 3.4. Diagram of the 1980 levels of treatment and replications (applied to the 5 to 15 percent vegetal cover block) 3.5

Figure 3.5. Diagram of the 1980 levels of treatment and replications (applied to the 15 to 25 percent vegetal cover block) 3.6

Figure 7.1. Sample size as a function of coefficient of variation in order to estimate sample mean within 15 or 20 percent at a 10 percent significance level 7.34

Figure 8.1. Qualitative relationshps for significant study variables 8.5

Figure 8.2. Qualitative relationships for other important variables 8.6

Conversion Factors: English to International System (SI)

Unit and Symbol	Multipliers Divisors	Unit and Symbol
Inches (in)	25.40	Millimeters (mm)
Inches (in)	2.540	Centimeters (cm)
Inches (in)	0.0254	Meters (m)
Feet (ft)	0.305	Meters (m)
Miles (mi)	1.61	Kilometers (km)
Yards (yd)	0.91	Meters (m)
Square inches (in^2)	6.45	Square centimeters (cm^2)
Square feet (ft^2)	0.093	Square meters (m^2)
Square yards (yd^2)	0.836	Square meters (m^2)
Acres (ac)	4,047	Square meters (m^2)
Acres (ac)	0.04047	Hectares (ha)
Square miles (mi^2)	2.59	Square kilometers (km^2)
Pint (pt)	0.4732	Liters (l)
Gallon (gal)	3.785	Liters (l)
Cubic feet (ft^3)	0.0283	Cubic meters (m^3)
Acre-feet (ac-ft)	1,233	Cubic meters (m^3)
Cubic inches (in^3)	16.4	Cubic centimeters (cm^3)
Cubic feet (ft^3)	0.028	Cubic meters (m^3)
Cubic yards (yd^3)	0.765	Cubic meters (m^3)
Ounce (oz)	28.35	Grams (g)
Pounds (lb)	0.4536	Kilograms (kg)
Tons (short (ts)	907.2	Kilograms (kg)
Tons (short) (ts)	0.9072	Metric tons (tm)
Pounds per square foot (lb/ft^2)	47.9	Newtons per square meter (N/m^2)
Pounds per square inch (lb/in^2)	6.9	Kilonewtons per square meter (kN/m^2)
Gallons (gal)	3.8	Liter (l)
Acre-feet (ac-ft)	1,233	Cubic meters (m^3)
Gallons per minute (gal/min)	0.004	Cubic meters per minute (m^3/min)
Miles per hour (mi/h)	0.447	Meters per second (m/s)
Feet per second (ft/s)	0.3048	Meters per second (m/s)
Pounds per square foot (lb/ft^2)	0.4885	Grams per square centimeter (g/cm^2)
Tons (short) per square foot (ts/ft^2)	0.9765	Kilograms per square centimeter (kg/cm^2)
Tons (short) per acre (ts/ac)	0.2241	Kilograms per square meter (kg/m^2)
Tons (short) per square mile (ts/mi^2)	350.2	Kilograms per square kilometer (kg/km^2)
Pounds per cubic foot (lbs/ft^3)	16.02	Kilograms per cubic meter (kg/m^3)
Cubic feet per second (ft^3/s)	0.0283	Cubic meters per second (m^3/s)
Cubic feet per second for one day (ft^3/s-d)	2,446	Cubic meters (m^3)

English Conversion Factors for Water Hydrology

Unit and Symbol	Multipliers Divisors	Unit and Symbol
Inches per hour (in/h) --------	1.008	Cubic feet per second (ft^3/s)
Inches per hour (in/h) --------	645.3	Cubic feet per second per square mile ($ft^3/s/mi^2$)
Surface inches (in) -----------	0.0833	Acre-feet (ac-ft)
Surface inches (in) -----------	645.3	Cubic feet per second per hour ($ft^3/s/h$)
Surface inches (in) -----------	26.89	Cubic feet per second per day ($ft^3/s/d$)
Square miles (mi^2) ------------	640	Acres (ac)
Acres (ac) --------------------	43,560	Square feet (ft^2)
Square feet (ft^2) -------------	144	Square inches (in^2)
Cubic feet per second-days (ft^3/s-d)	1.983	Acre-feet (ac-ft)
Miles per hour (mi/h) ---------	1.467	Feet per second (ft/s)

LIST OF SYMBOLS

BRO	Beginning of runoff from plot (min)
Ca	Calcium (mg/l)
Cl^-	Chloride (mg/l)
DISC	Total disturbed bare ground on the plot from cell method (%)
DISP	Total disturbed bare ground on the plot from point method (%)
DR	Duration of rainfall for each run (min)
EC	Electrical conductivity (μmhos/cm)
EC1	Electrical conductivity from total field sample (μmhos/cm)
EC2	Electrical conductivity from time weighted average (μmhos/cm)
ERO	End of runoff from plot (min)
Fl^-	Fluoride (mg/l)
HE	Height of plant on plot (inches)
K	Potassium (mg/l)
Mg	Magnesium (mg/l)
Na	Sodium (mg/l)
NQP	Normalized peak runoff (QP/RFR)
pH	Negative logarithm of the hydrogen-ion concentration
QP	Peak flow (ml/sec)
RFR	Rainfall rate for each run (cm/hr)
RO	Total runoff for each run (in)
ROCKC	Total rock cover on plot from cell method (%)
ROCKP	Total rock cover on plot from point method (%)
SLOP	Slope of plot
$SO_4^=$	Sulfate (mg/l)
TA	Total alkalinity as $CaCO_3$ (mg/l)

TBARC	Total bare ground on the plot from cell method (%)
TBARP	Total bare ground on the plot from point method (%)
TCOVC	Total cover on plot from cell method (%) Sum of VEGC, TLITC, ROCKC
TCOVP	Total cover on plot from point method (%) Sum of VEGP, TLITP, ROCKP
TDS	Total dissolved solids (g/l)
TLITC	Total litter cover on plot from cell method (%)
TLITP	Total litter cover on plot from point method (%)
VEGC	Vegetative cover on plot from cell method (%)
VEGP	Vegetative cover on plot from point method (%)
VOL	Total volume of runoff for each run (ml)

ACKNOWLEDGMENTS

This report was prepared for the Bureau of Land Management (BLM) by Simons, Li & Associates, Inc. (SLA) under Contract No. YA-553-CTO-1069. BLM personnel who significantly contributed to the study included Mr. S. Fisher (Technical Project Officer), Mr. Bill Jackson, Mr. S. Parsons, Mr. G. Bentley, and Mr. E. Janes. The assistance of these personnel greatly contributed to the success of the project. Additionally, the cooperation and timely service provided by Ms. D. Price (Contracting Officer) is appreciated.

SLA Project Specialists who contributed to the project, particularly during the first several months of the contract, included Drs. C. W. Cook, R. D. Heil and S. Ponce. Their experience and expertise was greatly appreciated. Finally, the sincere effort and dedication of the field crew members provided not only an efficient field season but resulted in data of extremely good quality.

I. INTRODUCTION

1.1 The Salinity Problem

The salinity problem is the most serious water quality problem in the Colorado River system. The average annual salt load of the Colorado River at Hoover Dam has been estimated to be more than 10 million tons annually, based on data for the period 1942-1961 (Bureau of Land Management, 1978). Further downstream at Imperial Dam the salinity level in terms of concentration averaged 865 mg/l in 1971, with a projected increase to 1340 mg/l by the year 2000. In the text of Public Law 96-375, annual economic damages resulting from salinity are estimated in 1979 dollars to be $343,000 per mg/l increase at Imperial Dam. Clearly economic considerations, as well as water quality standards and international concerns over salinity of the water flowing into Mexico, require consideration of all possible methods to reduce salt loading in the Colorado River system.

Increases in salinity concentrations from the headwaters to the mouth of a river result from the two basic processes of salt loading and salt concentrating. Salt loading is the addition of mineral salts from natural and man-made sources resulting in increased salinity due to increased total salt burden. Salt concentrating effects are produced by streamflow depletions, resulting in increased salinity by concentrating the salt burden in a smaller volume of water. An evaluation by the EPA (1971) indicated that 74 percent of the average salinity concentrations of the Colorado River at Hoover Dam for the 20-year period from 1942-1961 were attributable to salt loading factors.

Salt loads are contributed to a river system from natural and man-made sources of both point (discrete) and nonpoint (diffuse) origin. Natural nonpoint sources result from the passage of precipitation (rain or snow) induced runoff through saline soils and geologic formations (the runoff components include overland flow, channel flow and ground water flow). In contrast, man-made nonpoint sources include irrigation, or irrigation return flows, through saline soils and geologic formations. Other sources of salt loading are man-made point sources (municipal and industrial waste discharge) and natural point sources (mineral springs, seeps or other identifiable point sources).

Diffuse overland flow from public lands (lands under the jurisdiction of the BLM) is estimated to produce eight percent (700,000 tons) of the total Upper Basin salt load (BLM, 1978). The greatest quantity of this salt comes from rangelands that are relatively well covered with perennial vegetation and receive more than 12 inches average annual precipitation (67 percent of all public lands). Under these conditions, concentrations may be low, however total water yield can be high. The other significant overland flow source of salt from public lands are those areas containing saline geologic formations and soils. These lands receive less than 12, and typically six to eight, inches average annual precipitation (BLM, 1978). However, the storms generating this amount are primarily late summer thunderstorms of short duration and high intensity in very localized areas. Consequently, surge flows often develop in the valley channels, eroding and transporting large quantities of sediment. Under these precipitation conditions, vegetative cover is sparse and any use that disturbs the land causes increased erosion and salinity from overland flow. Possible disturbances to rangeland include grazing, off-road vehicles (ORV) and mineral-energy exploration and extraction.

1.2 Livestock Grazing Impact

Livestock grazing can have a significant effect on the hydrologic characteristics of rangeland, particularly the salt content of surface runoff. The degree of impact from grazing depends on the management practices followed. Damage occurs to rangeland when the carrying capacity of a particular region has been exceeded. Dasmann (1972) defines carrying capacity as the number of animals that can be carried on a plot and kept in good condition without damage to the range forage. Carrying capacity is therefore a function of the soil, climate, native vegetation and the tolerance of the vegetation to grazing. Areas of rangeland with deep soil and sufficient water have significantly more carrying capacity than those areas with rocky, arid conditions.

Overgrazing can weaken rangeland and create a condition of extreme sensitivity to prolonged periods of deficient soil moisture. Loss of vegetation promotes increased runoff and soil loss and alters the long-term balance, or equilibrium, of hydrologic processes that the rangeland has established. This impact was first observed on a large scale during the severe drought from 1933-1939 on the Great Plains rangelands where studies show (Albertson et al., 1957) loss of vegetation cover on heavily grazed ranges averaged nearly double that occurring on moderately grazed ranges, and more than double that occurring on ungrazed ranges.

The trampling effect of livestock can affect infiltration and runoff as a result of soil compaction and surface disturbance. Additionally, trampling can destroy both above-ground and underground portions of plants, resulting in a decrease in the quantity and vigor of the vegetation. These processes together can result in greater erosion and soil loss. Depending on the mechanisms of salt pickup, this can produce greater salt loading on downstream watersheds.

Different species of range plants have considerably different tolerance to grazing pressure. Each year perennial grasses produce a certain surplus of growth that can be safely grazed without damage to the plant. However, plants also have a necessary metabolic reserve requirement. This relates to the minimum leaf area and stems required to carry on photosynthesis for building and storing foods in the crown or root system. Annual grasses (those that die each winter) could theoretically be grazed to the roots, after going to seed, without damage to future generations. In reality, with annuals and perennials, a minimum amount of leafage and stem must be maintained to provide soil protection and to provide favorable conditions for germination. Therefore, grazing practices that eliminate the surplus and also the reserve portions of the plant can weaken or destroy rangeland.

Under heavy grazing the taller plants that generally make up the climax vegetation of prairies disappear and are usually replaced by more resistant grasses, often sod-forming. These grasses grow nearly horizontal to the ground and are less easily cropped by grazing. However, under continued heavy grazing even these will disappear, leaving bare ground where relatively unpalatable weeds will seed.

A classification scheme for range plants places different species in three general categories (Swenson et al., 1970; Dasmann, 1972). There are (1) decreasers, the tall climax grasses that are nutritious and highly preferred by livestock, and therefore the most valuable forage plants on the range, which decrease in number under moderate grazing; (2) increasers, species also present in the climax but in a lesser amount or subordinate position. They are often sod formers and are also nutritious and eaten well by livestock , but better able to withstand grazing use. These species increase in number or in space occupied as the tall climax grasses diminish. With very heavy grazing pressure even the increasers are killed out, and their place is taken by (3) invaders, native or exotic weeds or woody plants of low forage value, little use by livestock and generally not as well adapted to maintaining or holding the soil as the original vegetation. Therefore, proper range management includes maintaining a balance between increasers and decreasers and keeping the invaders to a minimum.

1.3 Project Objectives

Minimizing the adverse effects of grazing, particularly those related to salinity, requires the development of a management plan. Unfortunately, very little data are available on the effects of livestock grazing on salt concentrations in surface runoff. Therefore, the initial project objective was to develop a large data base from field investigations, using rainfall simulation techniques. The data base would then be used to quantify and analyze the effects of trampling by livestock on infiltration rates, runoff, sediment production and salt content of surface runoff from Mancos Shale-derived soils. Specific hypotheses to be tested in the analysis of the data were identified by BLM management. The hypotheses related to the hydrologic effects of varying degrees of livestock trampling, specifically:

- The effects are measurable
- The effects on runoff, salt and sediment production far outweigh the role of plant cover normally encountered on Mancos sites, and characterizing study sites selected.
- The effects on runoff, salinity and sediment increase with increased percent trampling disturbances.
- The effects are dependent upon the interaction of soil texture with antecedent soil water condition.
- Various degrees of trampling induce predictable physical changes in the soil water infiltration properties of Mancos Shale-derived soils.
- Effects of excessive trampling on infiltration rates are significantly different than those at lesser degrees of trampling.

In addition, other hypotheses to be statistically tested were:

- Plot runoff and soil loss are related.
- Percent bare soil is a good predictor of simulated storm runoff peak discharge and volume.
- Total salt production is independent of the amount of soil lost from a Mancos site plot via sheet and rill erosion.
- Infiltration characteristics are independent of percent of plot covered by coarse fragments.

The data collected in the study were expected to contain a wealth of information concerning the biotic and abiotic processes of grazing, salt and sediment production. Therefore, to achieve the maximum return from the study, the final objective was to insure this fundamental information was properly identified, organized and documented for use in further analyses.

1.4 Overview of the Scope of Work and Report Organization

The general premise of the study is that on soils derived from Mancos Shale the relative effects of surface disturbance from livestock on infiltration rates, runoff, sediment and salt production can be simulated, measured, and compared by application of small-plot rainfall simulation devices. Therefore, small-plot rainfall simulation devices were used to collect field data from test plots under controlled conditions. The study site was located in the Price River drainage basin, approximately ten miles northwest of Green River, Utah (see Chapter II). A total of 360 runoff events were simulated, consisting of three vegetative conditions, four trampling conditions, two antecedent moisture conditions and fifteen replications. The data collection occurred during the summer of 1981. During the previous summer (1980) a field data collection effort was initiated, but not completed for a variety of reasons. Chapter III discusses the experimental design for both field seasons and briefly discusses the problems of the 1980 field season. Chapter IV details the data collection procedures. Sample analysis procedures and tabulation of data are discussed in Chapters V and VI, respectively.

A statistical analysis involving descriptive statistics, two sample t-tests, analysis of variance, and correlation analysis were used to analyze the data and test hypotheses. Chapter VII discusses the analysis techniques and presents the results. Chapter VIII discusses the results and Chapter IX gives a summary and conclusion.

II. STUDY SITE DESCRIPTION

2.1 Local Characteristics of the Study Site

The study site was located approximately 10 miles northwest of Green River, Utah, just east of U.S. Highway 50, with a corresponding latitude and longitude of about 39° 05' and 110° 18', respectively. The area is part of the Green River drainage basin. Nearby major tributaries to the Green River include the Price and San Rafael Rivers. The approximate elevation at the study site was 4,050 feet, with topography of gently rolling hills. The soil was mainly fine textured and derived from the Mancos formation. Figure 2.1 shows the general location of the study site and Figure 2.2 the specific location.

Data from a nearby climatological station measuring precipitation, evaporation and temperature with both recording and nonrecording gages were considered as being representative of the study area. This station is located in Green River, Utah just inside Emery County. The area is semi-arid with an average annual precipitation of about six inches and an average annual temperature of around 50°F. The potential evaporation averages over 40 inches for the months of April through August. Precipitation amounts during the field season from a rain gage on the study site are given in Table 2.1.

Representative vegetation in the study area was salt shrub, and was dominated by two species of saltbush: Matt saltbush (*Atriplex corrugata*) and Nuttall's saltbrush (*Antriplex nuttallii*). On the upland areas both sulfur buckwheat (*Eriogonum umbellatum*) and evening primrose (*Oenothera* sp.) were associated with the previous two species. A more diverse composition of Castle Valley Clover, Nuttall's saltbush, sulfur buckwheat, evening primrose, Indian ricegrass (*Oryzopsis hymenoides*) and tobosa grass (*Hilaria jamesii*) was exhibited in the major drainages. Plate 2.1 depicts the general characteristics of the area.

2.2 Regional Climate and Vegetation

Climate and vegetation in eastern Utah vary with elevation which ranges from 4,000 feet near the Green River to over 11,000 feet in the mountains to the west. The higher elevations receive more than 30 inches of precipitation annually while parts of the lower elevations receive less than 8 inches. Weather records indicate extreme seasonal temperature fluctuations ranging from over 100°F in the summer to well below 0°F in winter. High summer temperatures coupled with frequently strong summer winds create high evaporation rates and arid conditions. Precipitation in the study region is greatly influenced by the Wasatch and Tavaputs Plateaus to the west and north, respectively. In winter and spring, when air masses approach from the west, these high plateaus force the air to rise and release moisture. This process creates a rain shadow over the middle and lower elevations of the basins. In summer and early fall, the mountains intercept moist air masses from the east as air moves up from the Gulf of Mexico. The uplift of air creates convective storms over the basins. Storms are most frequent in August, occurring as isolated, high intensity events and often resulting in flash flooding. From October through April most of the precipitation occurs as snow.

Vegetation ranges from desert communities to subalpine forests. The higher elevations support coniferous forest communities, while intermediate and lower elevations support mainly pinyon-juniper, salt brush, desert shrub,

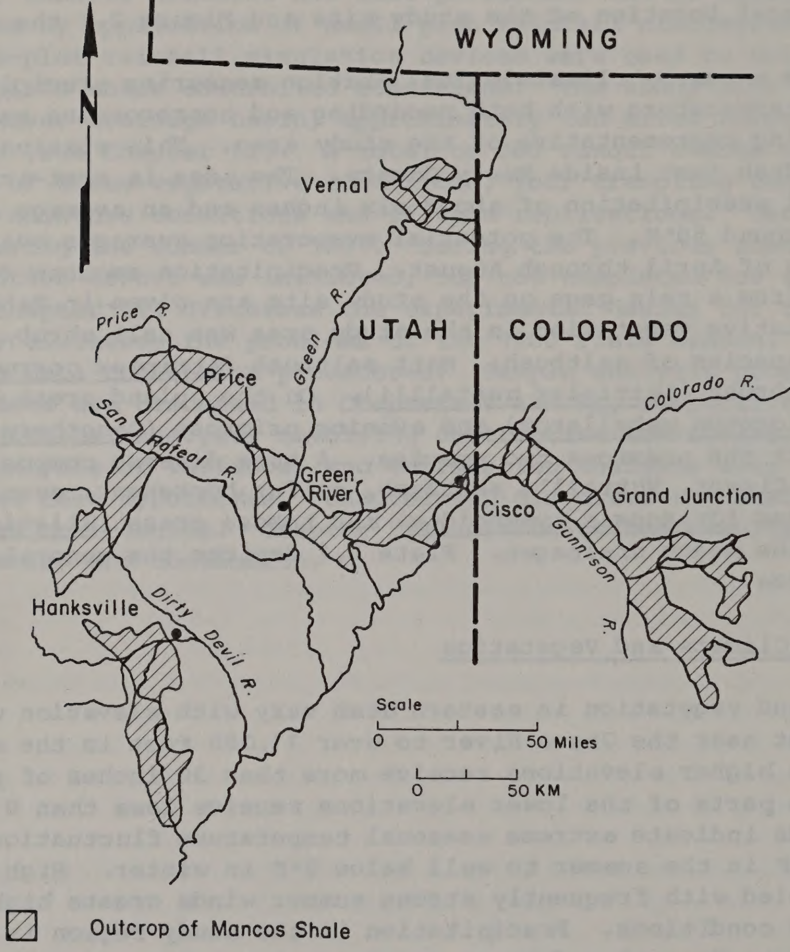


Figure 2.1. Regions of exposed strata of Mancos formation (after Williams, 1975).

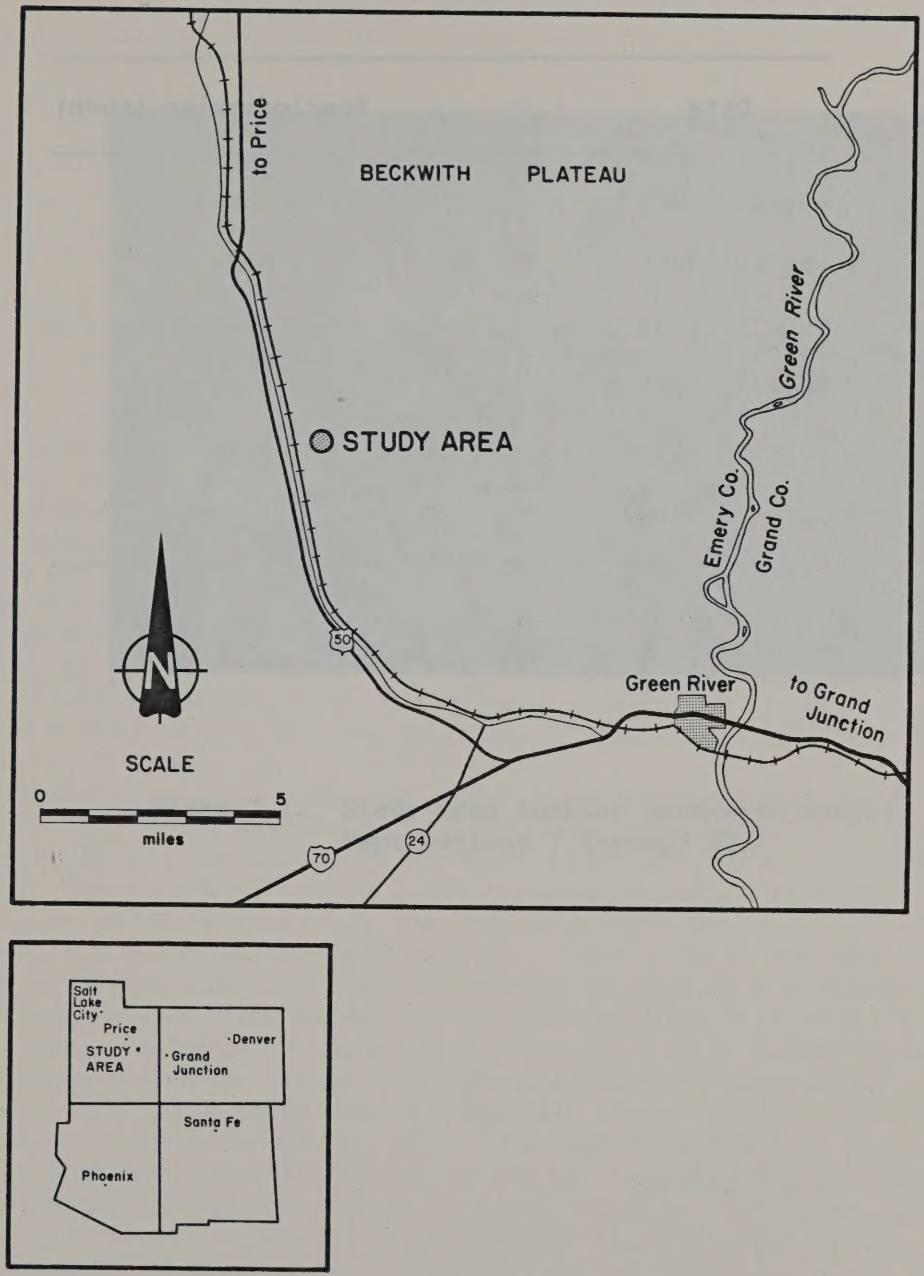


Figure 2.2. Study area map.

Table 2.1. Precipitation Amounts During the Field Season.

Date	Precipitation (inch)
May 20, 1981	0.054
May 28, 1981	0.13
May 29, 1981	0.10
June 3, 1981	0.04
June 28, 1981	0.02
June 29, 1981	0.23

Plate 2.1. Study area looking northwest across Replications 7 through 10.

and big sagebrush communities, with greasewood in narrow bands along the streams. In general, principal plant communities in the headwaters are Subalpine forest and big sagebrush (Artemisia tridentata) with a mixture of pinyon-juniper (Pinus edulis-Juniperus osteosperma), shadscale (Atriplex confertifolia) and greasewood (Sarcobatus vermiculatus) in the middle and lower portions of the basin (Connon, 1960; Shantz and Zon, 1964).

2.3 Regional Geology and Soils

The study site was located in an area that is part of the physiographic unit known as the Colorado Plateau Province. The Colorado Plateau Province is essentially a sedimentary province characterized by flat-lying sedimentary rocks, few intrusive igneous rocks and relatively simple fault and fold structures. The sedimentary rocks associated with this area are characterized by a deposition environment of alternate advances and retreats of seas from the western part of the state. Sands and muds of shallow environments were succeeded in deeper water by thick sequences of limestone, shale and dolomite. The geologic formations, or members which have been instrumental in contributing salt to lands in the Upper Colorado River Basin of Utah, are summarized in Table 2.2 in order of oldest to most recent.

As Mundroff (1972) noted for the Price River, "Most of the central basin is underlain by the Mancos Shale of Cretaceous age, a marine shale that is commonly carbonaceous or gypsiferous. The Mancos Shale is the predominant geologic influence on the chemical quality of the water in the central basin." The Mancos shale is divided into three distinct members, Masuk, Blue Gate, and Tununk, which are separated by identifiable sandstone fingers (Table 2.2). The Blue Gate member contains large quantities of evaporites and gypsum (Thorne, et al., 1967). Numerous saline deposits are observed on soils derived from this geologic member. Below the Blue Gate member, separated by the Ferron sandstone, is the Tununk, which is the oldest member of the Mancos formation in the area.

A detailed soil survey by the Soil Conservation Service (SCS) is limited to a narrow band of predominantly agricultural lands between the Wasatch Plateau and the San Rafael Swell, commonly known as Castle Valley (Swenson, et al., 1970). However many of the soils present elsewhere throughout the basin are described in the survey. In general, the soils evolved from three main types of parent material (Swenson, et al., 1970). Soils derived from residuum shale and sandstone are typically saline and contain high concentrations of gypsum. Soils resulting from glacial outwash derived from sandstone and quartzite are calcareous and have good drainage. Soils formed by weathering of alluvium or colluvium of shale or glacial outwash are generally poorly drained and contain numerous salts. The soil associations of Castle Valley reported by the SCS (Swenson, et al., 1970) are summarized in Table 2.3.

Soils within the Saltair-Libbings and the Chipeta-Persayo-Badland associations are considered to be prime sources of salt. All these associations form over gypsum-bearing shale, while the Saltair and Libbings are reported as having 2 percent salt within 20 inches (51 cm) of the surface and their profiles contain distinct gypsum horizons (Swenson, et al., 1970).

Much of the area contains soils classified as entisols and aridisols. Entisols are youthful soils in which no soil horizons are apparent. Regionally, entisols occur in arid and semiarid zones and are normally saline. Entisols are very fragile soils that yield large sediment and salt loads when

Table 2.2. Geologic Formations or Members Contributing Salt to Lands in Eastern Utah (from USBR, 1975).

Name	Age	Approximate Thickness (feet)	Description of Materials
Moenkopi	Early Triassic	0-400	Brick red-colored mudstone of of fresh and brackish ponds, playas, and shallow seas. Beds of gypsum and casts of salt cubes included. Slightly to moderately salty.
Chinle	Late Triassic	0-350	Variegated mudstones and shales of slight to moderate salt content.
Carmel	Early Jurassic	150-650	Gypsum, red and green shale. Slight to moderate salt content.
Curtis	Jurassic	75-250	Slight to moderate salt content.
Summerville	Late Jurassic	260-330	Chocolate siltstone with gypsum veinlets. Slight to high salt content.
Morrison (Brushy Basin)	Late Jurassic	250-400	Varicolored mudstones and lacustrine limestone of continental origin of possible semiarid conditions. Includes reworked volcanic ash. Slight to moderate salt content.
Cedar Mountain Shale	Early Cretaceous	250-700	River floodplain deposits. Slightly saline.
Mancos Shale Tununk member) Blue Gate member) Masuk member)	Early Cretaceous	 400-700 1,500+ 0-800	Grayish, drab shales of marine origin (last of seas in Utah). Moderately to highly saline.

Table 2.2 (continued)

Name	Age	Approximate Thickness (feet)	Description of Materials
Tropic Shale	Early Cretaceous	610-640	Similar to Mancos but occurs only in southern Utah. Moderately to highly saline.
Wasatch	Paleocene	500-2,000	Colton member is reddish-brown and tan silty shale and sandstone. (Three members in the Price-Soldier Summit area). Largely nonsaline-alkaline.
Green River	Eocene	1,000+	Green, calcareous siltstone oil shale. Nonsaline to slightly saline.
Uinta	Eocene	2,500-3,000	Slight reddish fluviatile and lacustrine sandstone, siltstone, and shale. Slightly to moderately saline.
Duchesne River	Oligocene	1,500	Reddish, gray, buff sandstone and sandy shale. Slightly saline.

Table 2.3. Soil Associations Present in Castle Valley (after Swenson, et al., 1970)

Association	Brief Description
1. Chipeta-Killpack	Moderately fine textured soils that are well drained and shallow to moderately deep over shale; on uplands that are gently rolling and sloping to moderately steep slopes.
2. Ravola-Billings-Penoyer	Medium and moderately fine textured soils, that are well drained; on near-level alluvial deposits.
3. Saltair-Libbings	Moderately fine textured soils that are moderately deep and salty; on lowlands and foothills.
4. Sanpete-Minchey	Moderately fine textured soils forming over gravel; on benches, mesas, and alluvial deposits.
5. Chipeta-Persayo-Badland	Moderately fine and medium textured soils that are well drained shallow over shale and eroding shale outcrops; on uplands.
6. Rock Land-Shaly Colluvial Land-Castle Valley-Kenilworth	Gently sloping to very steep, shallow to deep, gravelly and stony soils, and rock land; on benches and hills.

disturbed or compacted. Aridisols also occur in arid and semiarid zones. The moisture content of aridisols is low because of low precipitation and high runoff rates. High runoff results from high intensity storms and from high clay content of soils or impervious soil crusts. Aridisols are also very unstable and erodible when the surface layer is disturbed.

The 1977 Status Report on the Effects of Surface Disturbance on the Salinity of Public Lands in the Upper Colorado River Basin (BLM, 1978) has considered the inherent physical and chemical soil properties that have important influences on salt movement. Some of the more significant results are reviewed in the following paragraphs.

Soils on exposed Mancos Formation are fine-textured and nonsaline in the first 12 inches, but become saline at greater depths. Soil texture is reported to have a significant influence on runoff, up to a threefold increase from a medium to a fine-textured soil. Since Mancos Shale soils are fine-textured, a relatively high degree of runoff can be expected to occur. Additionally, the clay content of Mancos Shale produces a high degree of swelling whereby permeability decreases and runoff increases. Particle size is also important to compaction; medium-textured soils (greatest range of particle size) compact the most. Soils that are high in organic content have reduced compaction since the plant material acts as a cushion and prevents pore space from being filled.

Mancos Shale-derived soils are high in calcium, magnesium, sodium and potassium cations. Gypsum ($CaCO_4 \cdot 2H_2O$) is reported as the most common component of salt. Gypsum solubility increases 1.7 times by the addition of sodium chloride and magnesium chloride. The runoff of Mancos Shale-derived soils generally becomes saturated with gypsum when the electrical conductivity (EC) is about 2500 μmhos/cm, (EC is a measure of dissolved solids and provides an estimate of salt content).

Soil chemical and physical properties are interrelated. For example, the cation exchange capacity, defined as the ability of a soil colloid to hold cations, is dependent on the colloids present (clay content), the type of colloids (mineralogy) and the organic matter content. The cation exchange capacity of a soil is an important parameter because it determines the nutrient holding capacity and the nutrient requirements of a soil.

Under heavy grazing, or other activities resulting in compaction, soil is generally shallower, plant roots decrease greatly with depth, and bulk density is increased. These changes influence water infiltration and reduce percolation rates. The reduced infiltration and percolation create long-term, low-water storage that reduces the intensity and vigor of vegetation. On ungrazed rangeland soils typically exhibit high infiltration and percolation rates and abundant, deeply rooted plants use the stored soil moisture. These plants contribute to the granular structure and increased porosity of soil, thereby maintaining infiltration, percolation and water storage.

A complicating factor related to soil permeability, infiltration and percolation is the extent of a soil condition known as vertic-intergrade. A clay-rich soil can possess a blocky structure and exhibit large cracks which provide conduits of rapid downward flow. Based on personal observations and communications, a condition nearly equivalent to the vertic-intergrade condition is estimated to exist on about one-third of all the Mancos Shale-derived soils in the project area, and could be a significant contributor to the salt loading mechanism of ground water. Additionally, this soil condition could contribute to the accumulation of salt evaporite often occurring at the surface of saline soils. It is hypothesized that during a rainfall event, the lower soil profile is rapidly wetted through the vertical cracks. Soil water within these layers is held at a relatively high soil-water potential compared to the upper layers, which are drier (lower soil-water potential). The water in the lower profile may reach the root zone and become utilized by the plants. Alternatively, it may reach overlying soil layers through capillary rise and evaporate at the surface. Hence, any salts within the soil water are concentrated on the soil surface.

2.4 Regional Hydrology

Most of the area's water supply comes from spring snowmelt in the higher elevations. In the lower portions of the drainage basins, stream channels are deeply eroded below the adjacent lands. Runoff from the lower areas is erratic, much of it being the result of violent thunderstorms in late summer and early fall. While these storms are difficult to monitor and analyze, they are potentially major transport mechanisms for salt loads. Runoff from these storms is characterized by high flows of short duration with heavy loads of salt-bearing sediments. Many of the tributary streams flow intermittently, varying through the year from no flow to thousands of cubic feet per second. Ground water in moderate quantities is available from aquifers which are in bedrock or consolidated formations. The bedrock generally yields water slowly to wells but can yield water readily when the formation is fractured. Recharge to the ground water system in the area occurs from precipitation which falls on permeable formations that crop out along the flanks of mountains or folds. Surface streams that flow across these permeable formations also provide a source for recharge to the ground water system. Recharge in the valleys is small because of the low normal annual precipitation.

2.5 Historical Industry and Agriculture Trends

The principal means of livelihood in the region are coal mining and related activities. The upland areas contain numerous underground mines which serve as the principal source of coking coal in the western United States (Hackman, Bigler, and Kirk, 1968). Coal produced from these mines is shipped by rail or truck to steel mills in Utah and California.

In general, farming and ranching are confined to the central and lower basins. The lack of precipitation and poor soils of the area restrict both activities. Currently all soils in cultivation require irrigation. Irrigated lands raise sugar beets, hay, feed corn, and grains. The range lands are grazed by both cattle and sheep. However, most of the range sites in the basin are in poor to fair condition (Swenson, et al., 1970). The majority of livestock producers in the area own small herds (less than 50 cattle and/or less than 600 sheep) and supplement their incomes by working in the local coal mines or for county or state governments.

The experience of more than 90 years has demonstrated that the land is unsuitable for agriculture without irrigation, that water is not plentiful, and that, of the considerable acreage once thought reclaimable, only a small part could be profitably cultivated. Thus, the principal use of vast land areas is grazing for cattle and sheep, and on the small cultivated areas, production of hay and grains for winter and supplemental feeding. Livestock is generally shipped to large feeding and fattening operations outside the State.

Agricultural statistics for Emery County (from USBR, 1975) are shown in Table 2.4. When the value of products sold is equally divided, the gross

Table 2.4. Agricultural Statistics for Emery County (USBR, 1975)

	Unit	Emery
Farm and farm land		
Number of farms	No.	353
Average farm size	Acres	798
Irrigated acres per farm	Acres	109
Values of agricultural products sold		
Crops (including forestry)		300,000
Livestock and products		2,329,000
Total Value		2,629,000
Value of farms and expenses		
Value of land and buildings		7,216,000
Market value of machinery and equipment		2,620,000
Farm production expenses		2,195,000
Crop land and production		
Wheat		
Acres	Acres	1,652
Production	Bu.	2,845
Corn for silage	Acres	1,428
Oats		
Acres	Acres	1,785
Production	Bu.	95,621
Hay		
Acres	Acres	15,254
Production	Tons	1,418
Barley		
Acres	Acres	551
Production	Bu.	29,916
Livestock		
Cattle and calves	No.	22,960
Sheep and lambs	No.	18,851

sales of $8,200 per farm is a relatively low figure. Because of the area's isolation, the long distances to markets, and the lack of a dependable water supply, no cash crops of any significance are grown.

2.6 Related Salinity Studies

Ponce (1975) studied the processes of overland flow and its relation to salt transport on undisturbed rangeland in the Price River Basin. The specific objectives of this study were (1) to determine the role of overland flow on salt movement for selected land types, (2) to determine the relative magnitude of surface erosion associated with overland flow and its role in the salt release process, and (3) to develop a nonpoint source loading function to predict salt production from diffuse sources. The initial studies performed by Ponce were at the reconnaissance level, to spotlight the major salinity source areas as defined by the geologic origin of the soils.

A summary of the results is given in Figure 2.3. This figure shows (1) highest concentrations of salts in surface runoff are obtained in the initial stages of runoff (first 13 to 18 minutes), (2) the Undivided Mancos and the Lower and Middle divisions of the Blue Gate member produce conspicuously high salt concentrations in the surface runoff, and (3) the quality of most of the surface runoff water is fairly high relative to the Price River. Ponce estimated that roughly 0.5 percent of the total salt load of the Price River at Woodside was contributed by overland flow.

Additional testing by Ponce found rainfall intensity to be related to runoff salinity through two basic processes. First, when a change in rainfall intensity was not accompanied by a direct change in erosion rate, the salinity of the runoff varied inversely with rainfall intensity, suggesting that the dilution phenomenon dominates. Second, when rainfall intensity was increased and accompanied by erosion, salinity of runoff varied directly with intensity, suggesting that salinity was directly related to the mineral salts associated with the sediment. These two processes are similar to Hillel's (1980) concept of flux-limited versus profile-limited processes of infiltration.

Channel flow processes range from rill and gully development on hillslopes to the major streams and channels draining a watershed. As these channels traverse saline geologic formations and soils, additional salt pickup can occur. In a continuing research effort related to the work of Ponce, White (1977) considered salt production from small ephemeral channels in the Price River Basin. Salinity in channelized surface runoff was found to be closely related to accompanying channel erosion. A simple linear function was found to adequately describe the relationship. The coefficients of the relationship were site related and associated with measurable soil chemical and physical properties. In a fashion similar to Ponce, White estimated the salt load contribution from microchannels on Mancos members to be 2.4 percent. White concluded that research is needed to expand the salt-sediment concept to areas other than the Price River Basin.

A related study also found erosion processes to be particularly significant to salt loading. Laboratory and field studies by Sunday (1979) indicate that on Mancos shale soils, slope and the effects of rilling contribute to high levels of salt in runoff. Slope is identified as a major factor in areas which potentially contribute high levels of salt to runoff by: (1) the slope relationship derived in field studies, (2) increased rill lengths on steep slopes, demonstrated by computer simulation and corresponding increased sediment yields, and (3) the EC-velocity relationship developed in a laboratory

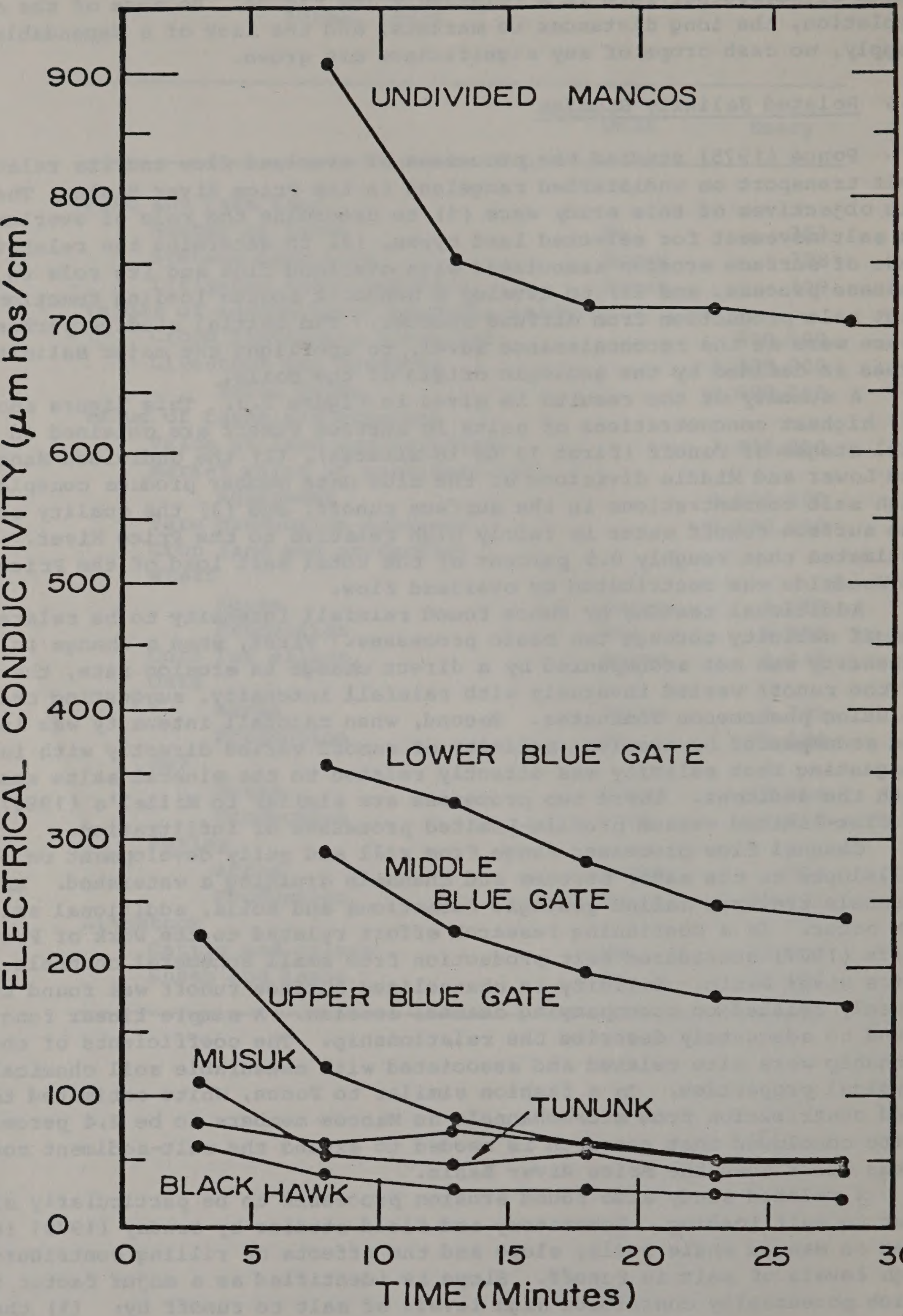


Figure 2.3. Mean electrical conductivity of surface runoff for selected geologic types. Time is from the beginning of rainfall (from Ponce, 1975).

experiment. Rilling is a dominant salt transport mechanism as evidenced by: (1) increases in EC of the runoff after rilling was noted in hillslope studies, even if rilling does not occur immediately, (2) increases in EC caused by agitation from higher velocities, (3) higher salinity potential of the lower, unweathered layers of shale exposed by the rilling, and (4) increases in EC associated with increasing the surface area exposed to flow. Field studies of salinity in runoff were conducted by applying runoff directly to the hillslope through a perforated pipe and, secondly, by rainfall simulation to produce runoff. Average EC was found to increase with increasing values of slope and rilling of the hillslope.

Additional studies have shown (Laronne, 1977; Shen, 1981) that EC measurements of surface runoff are not reliable indicators of the total salt yield of the area. Results of research reported by Laronne suggest that sediment-laden water from streams such as the Price River, often in equilibrium with respect to gypsum, may contribute increased quantities of salts to more diluted rivers such as the Green and the Colorado. In addition, higher channel velocities and increased turbulence will produce higher dissolution rates. Therefore, sediment is an important contributor to salt yields from geologic formations containing large amounts of salt, such as the Mancos and Mesa Verde. Laronne also found that addition of distilled water to sediment-laden water taken from the Price River increased salt yields as much as 500 percent.

Research by scientists at the University of California, Davis, has been conducted at the West Salt Creek watershed (Whittig, et al., 1979; Tanji et al., 1977), which discharges into the Colorado River near Grand Junction in west central Colorado. Results substantiate the general conclusion that geologic strata of the Late Cretaceous Mancos formation are the major source of mineral salts in the watershed. Additionally, the results have demonstrated the great variability in mineral salt content and mineral salt species that exists between different stratigraphic units of the Mancos formation, and between physiographic landforms and soils developed thereon. Combined laboratory and field investigations have provided the basis for delineation of four major geologic formations and six geomorphic landforms within the watershed that can be categorized by low, intermediate or high soluble salt levels. Exposed, highly dissected nonmarine sedimentary geologic strata of the Mesa Verde, Wasatch and Green River formations provide the surficial features of the upper, approximately three-fourths of the watershed. In general, these three formations were found to be low in soluble salts, yielding electrical conductivities (EC) in 1:5 extracts (mineral matter:water suspensions) of from 0.15 to 0.90 μmhos/cm. The lower reaches of the watershed, dominated by marine shales and interbedded sandstones of the Mancos formation, exist as old erosional surfaces, pediments and cuestas, with gently sloping relief. Stabilization by resistant sandstone lenses, by stream gravels laid down on the erosional surfaces, or by carbonate caliche were found to effectively shield the underlying highly saline Mancos shale from erosion and leaching, resulting in very low soluble salts (EC 0.06 to 0.37 μmhos/cm). However, where downcutting streams have dissected and eroded pediment and cuesta surfaces, large areas of highly dissected, highly saline Mancos shale badlands, as well as low-relief erosion-smoothed Mancos shale, are exposed, resulting in higher EC (EC 2.12 to 4.80 μmhos/cm) and were considered to be the major source areas for soluble salts discharged from the watershed. The most extreme levels of soluble salts occurred at evaporative surfaces near seeps in Mancos shale and stream bank alluvium, and in dry stream beds (EC as high as 72 μmhos/cm) that are particularly subject to dissolution and transport as storms or snow runoff increase channel flows. The specific soluble salts identified were Na, CO_3, HCO_3, Cl and SO_4. Soluble ions derived from Mancos shale, as reflected in evaporite specifics in associated salt efflorescence, were predominantly Ca, Na, Mg and SO_4. Additional laboratory studies have been conducted examining the role of the Mancos shale cation exchange complex as a contributor of soluble ions (Evangelou et al., 1981a) and the magnitude and rates of dissolution of Ca and Mg from alkaline earth carbonates and of desorption of Ca and Mg from the cation ion exchange complex (Evangelou et al., 1981b).

III. EXPERIMENTAL DESIGN AND ESTABLISHMENT OF TEST PLOT CONDITIONS

3.1 1981 Field Season

The 1981 field season was designed to collect data under 24 conditions with 15 replications, resulting in 360 total runs. The 24 conditions consisted of three vegetation types (matt, nuttal, bare) and four trampling intensities (none, minimal, moderate and excessive) tested under dry and wet antecedent soil moisture. The dry run was conducted first on each plot and then followed by the wet run. The wet run was initiated after the soil moisture reached field capacity (see Chapter IV). Figure 3.1 summarizes the experimental design.

The replication blocks were 4000 ft^2 in area and within each block were twelve plots representing each combination of vegetation and trampling intensity (three vegetation types times four trampling intensities equals 12 combinations). The replication blocks were laid out by BLM and SLA personnel during a site reconnaissance trip. Figure 3.2 gives the layout of the replication blocks relative to the dirt roads used to access the site.

Two weeks prior to the start of rainfall simulation, SLA staff located the 12 study plots within each replication. Freedom in the selection of plots was limited due to sparse vegetation in the region. The replication blocks were visually divided into quadrants and within each quadrant a bare plot, a plot with a matt and a plot nuttal saltbush were located. It was not considered feasible to place a plot frame over part of a plant due to the disturbance that would be generated when driving the plot frame into the ground. Therefore, an effort was made to avoid large bushes since the plant density in the test plot would not be representative of the natural vegetative cover. However, this was not always possible and represents one of the limitations of small-plot rainfall simulation research. The selected plots were diagonally staked and labeled to allow trampling treatment. Schematics of each replication block showing test plot locations are given in Appendix A.

To simulate trampling intensities or grazing patterns, a steer weighing approximately 1000 pounds was halter-led across the test plots. Different intensities were generated by making a different number of passes across the plot. The number of passes made for minimal, moderate and excessive trampling intensities were one, five and ten, respectively. During vegetation and resource classification the exact trampling intensity was evaluated for each plot. The deviation between plots of a given intensity was minimal. The average intensity for minimal, moderate and excessive trampling was 8, 35 and 60 percent.

3.2 1980 Field Season

The original scope of work required 540 experiments consisting of three vegetative covers, five trampling intensities, two antecedent soil moisture conditions at the time of trampling (dry and wet), two antecedent soil moisture conditions at the time of the run (dry and wet), and ten replications. Figures 3.3 through 3.5 summarize the original experimental design.

During late July of 1980 a site selection trip was conducted by SLA and BLM personnel. Based on the consistency of soil characteristics, slope and vegetation, as well as accessibility and security, a location five miles east of Green River was selected as the best test site and the one with the greatest potential to meet all of the project objectives. The only concern

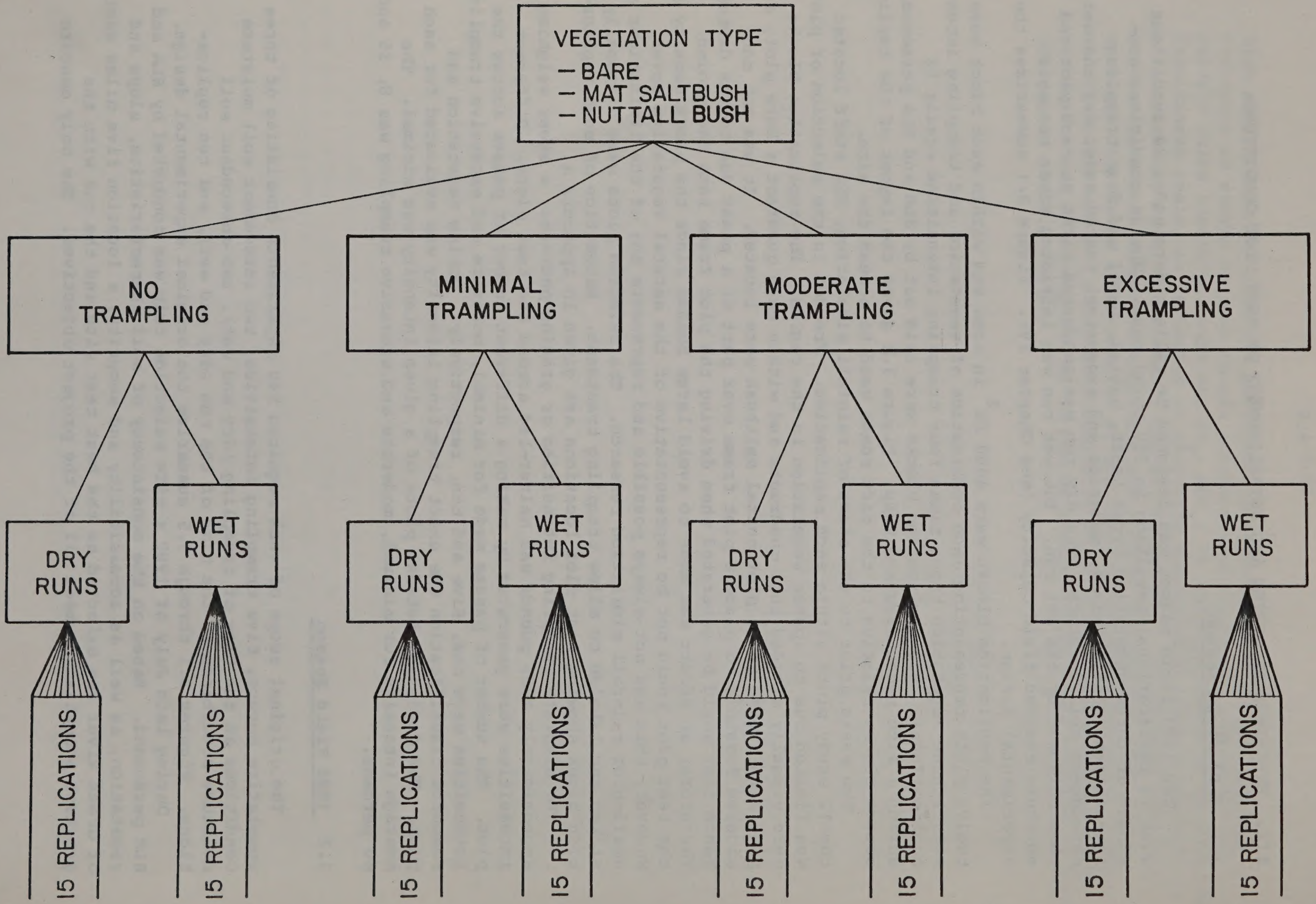


Figure 3.1. Diagram of 1981 levels of treatment and replications (applied for each vegetation type).

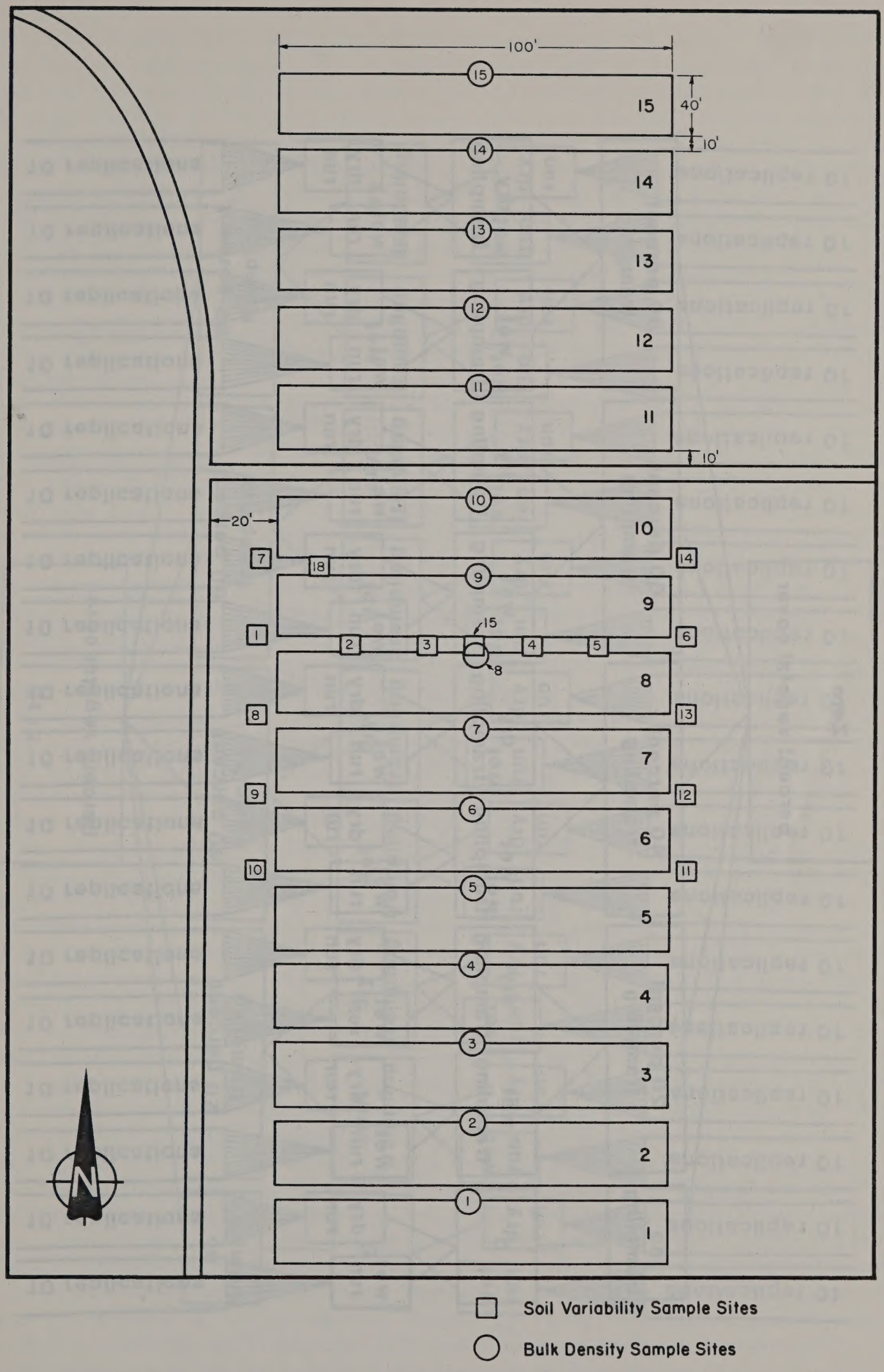


Figure 3.2. Layout for replication blocks.

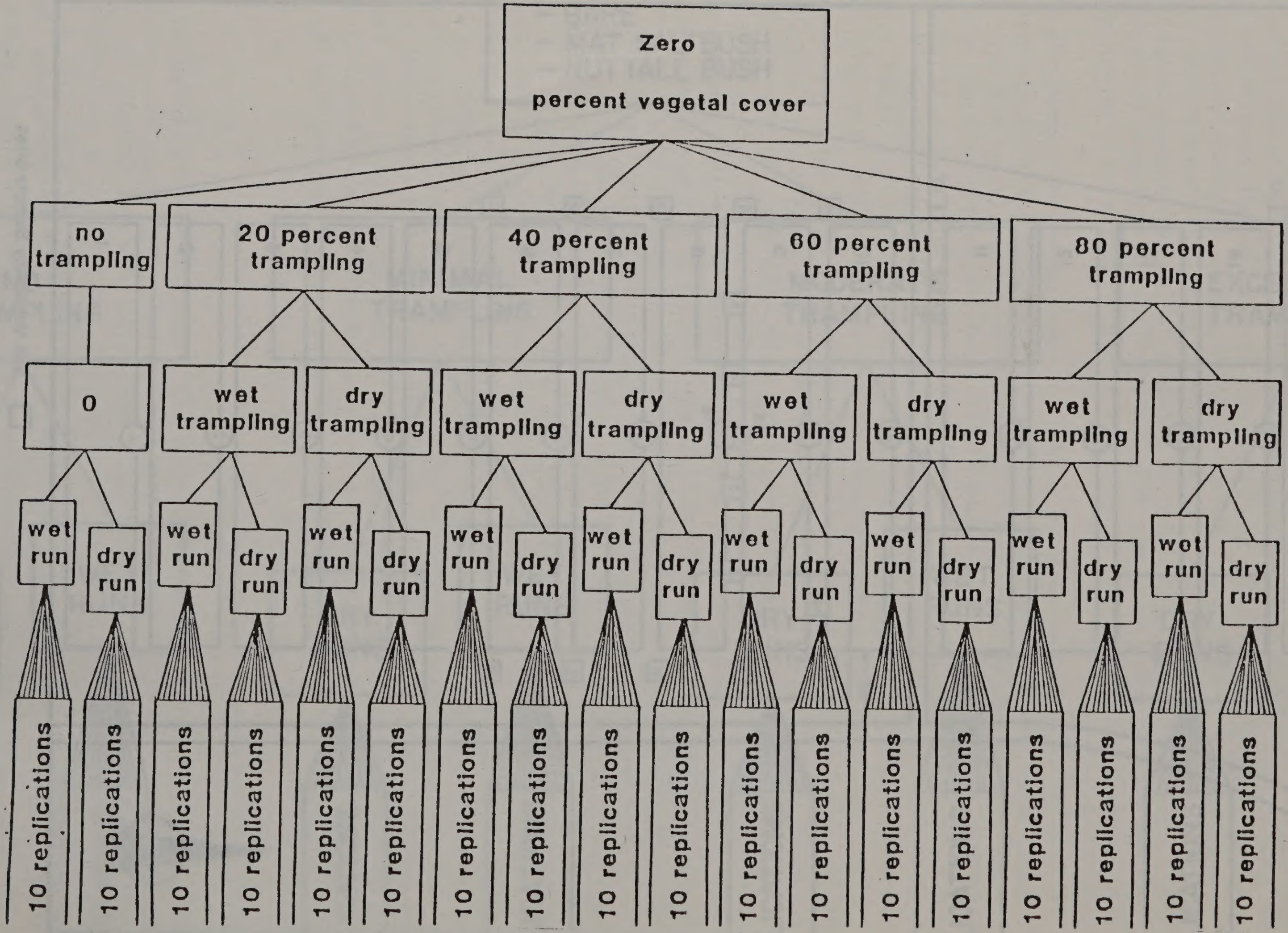


Figure 3.3. Diagram of the 1980 levels of treatment and replications (applied to the zero percent vegetal cover block).

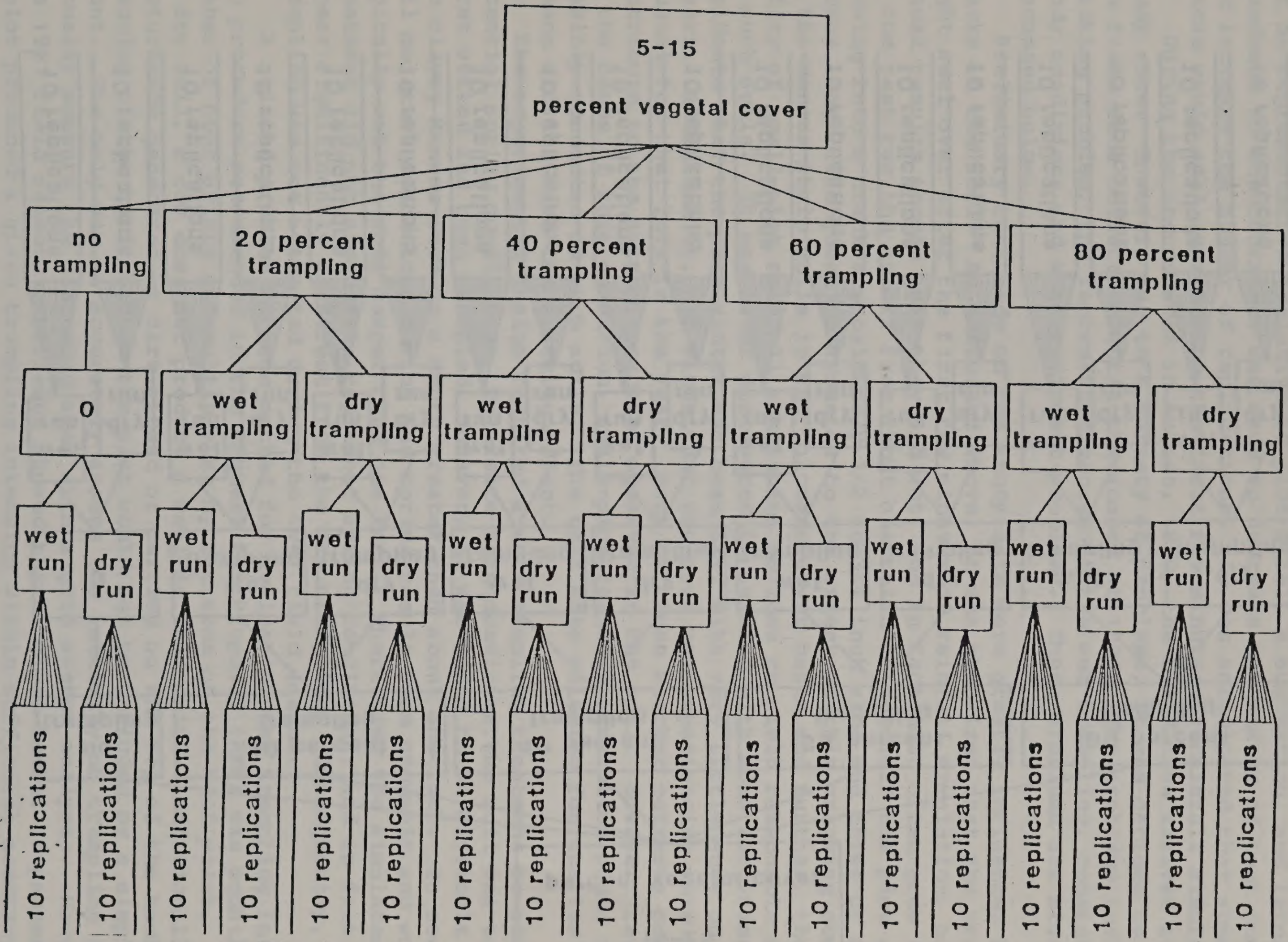


Figure 3.4. Diagram of the 1980 levels of treatment and replications (applied to the 5 to 15 percent vegetal cover block).

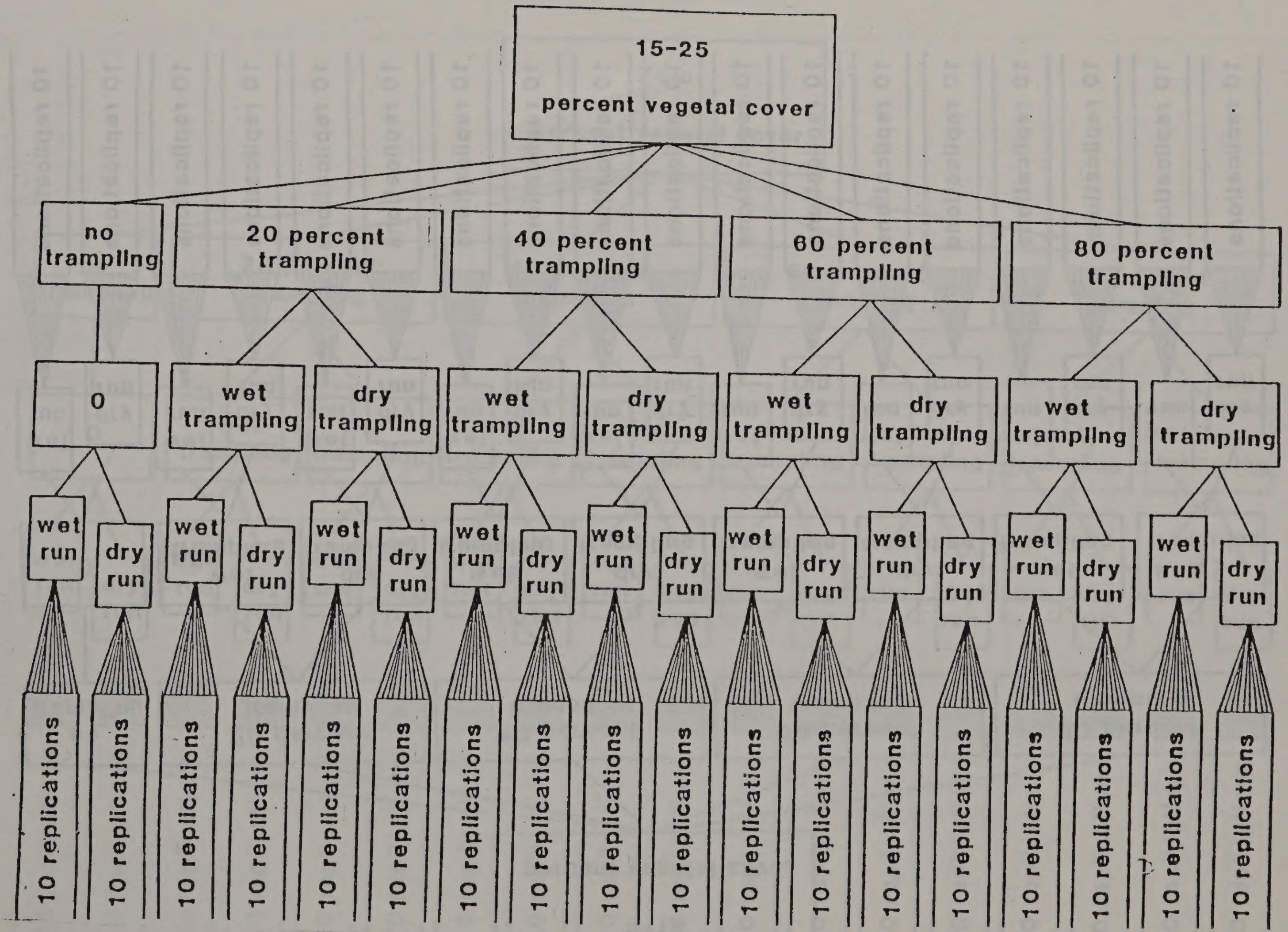


Figure 3.5. Diagram of the 1980 levels of treatment and replications (applied to the 15 to 25 percent vegetal cover block).

with the site was the existence of large cracks in the soil, initially thought to be vertic intergrades. The potential problems this created were evaluated and discussed at length during the trip. Based on concerns that larger cracks might develop and infiltrate quantities of water during the run which would not be representative (relative to plot size), a suggestion, and later an amendment to the contract, was made to decrease the number of test conditions and increase the number of replications. It was anticipated that some of the cracks would seal over during the first few minutes of rainfall simulation.

During the second week in August, 1980, the field crew arrived at the study site. However, due to a variety of problems, it was decided to postpone the field data collection until the summer of 1981. The problems included the cracking problem, the representativeness of the wet trampling, consistently windy conditions and some equipment problems. These problems are briefly discussed below.

Preliminary runs made on the study site were greatly influenced by the cracks in the soil. As discussed above, it was theorized that the cracks might seal over after the first few minutes of rainfall simulation; however, actual results showed that they did not, and in fact most often grew in size. On one test run the runoff from about one-third to one-half the plot was flowing into a crack approximately 1/2 to 3/4 inch wide and three or four inches long. The question arose as to the extent of this cracking condition in the Mancos shale soils in the Colorado River basin and further, the feasibility of small-plot rainfall simulation devices to yield reasonable results on such soils. It was later discovered in talking with some long-time local residents that the past winter had been dry, with very little snow on the desert. Additionally, the winds that the area was experiencing were extremely unusual for that late in the year. Both of these weather patterns could contribute to the extreme cracking observed in the soil. However, regardless of the cause of this condition, small-plot rainfall simulation could not be feasibly conducted on such soils. The test site selected for the 1981 field season did not have the cracking effect.

The experimental design required a wet trampling treatment to simulate potential spring conditions. To create this condition the soil was to be first wetted and then trampled; however, it was found to be difficult to wet the clayey Mancos soil to a depth greater than about one inch. In contrast, soil moisture conditions during the spring result from snowmelt and would typically wet the soil deeper than one inch. Therefore, the simulated wet treatment did not adequately represent spring conditions, and in fact did not appear significantly different from the dry trampling. Consequently, wet trampling was not attempted during the 1981 field season.

A related problem was the method for evaluating the trampling intensity. The procedure recommended in the Request for Proposal (RFP) was counting the number of hoof prints and multiplying by the area of the hoof print. However, in dry soil, a cow does not produce a well-defined print. Additionally, the disturbance generated by dirt kicked or carried on the top of the hoof and any dragging of the hoof through the plot would not be included by a simple hoof count. The only way to accurately assess the intensity of trampling is to actually measure the disturbed area with a grid system analysis. However, in the 1981 field season, experience showed that a given number of passes through a plot produced a given trampling intensity within sufficient accuracy.

The equipment difficulties and the wind problems were somewhat related and included problems in achieving a spatially uniform rainfall over the test plot. The primary problem was due to an improper drop tube specification in the RFP that resulted in a simulator which operated under gravity instead of pressure. The tubes used in the simulator were too large to allow pressure to develop in the precipitation plate and consequently the plate had to be perfectly level to provide the same hydraulic head over each tube. With gusty wind conditions it was virtually impossible to establish or maintain this condition. The problem was resolved for the 1981 field season by replacing the 0.0188 inch inner diameter drop tubes with 0.0135 inch inner diameter tubes. Additionally, free-standing wind screens were designed and used in the 1981 field season.

Considering the above difficulties, the field collection was postponed to allow adequate time to resolve the various problems. Due to the late date of contract award and the possibility of an early frost, it was not feasible to reschedule the field data collection until the following summer (1981). To compensate for the costs of the 1980 field season, including rebuilding the rainfall simulators, the number of runs was reduced from 480 to 360.

IV. FIELD DATA COLLECTION PROCEDURES

4.1 Rainfall Simulator

The use of deionized water in the field work required an efficient simulator to avoid excessive water hauling. Additionally, the number of experiments required a small, easily transported and operated system. Considering these limitations, a modular type drop forming rainfall simulator was selected for use (Plate 4.1). Drop-forming simulators produce very consistent and uniform rainfall over small test areas using relatively small quantities of water. However, typical of drop forming type systems, the terminal velocity and kinetic energy of the simulated raindrops relative to natural rainfall is low, due to drop fall distance and zero initial velocity. However, this was not considered a serious limitation since the project objectives were to compare the results of the different treatments in a relative manner. Plot size and other considerations further limited the value of analyzing the results in an absolute fashion.

The rainfall simulator consisted of a 3 by 3 foot precipitation chamber with 23 gauge hypodermic tubing (0.0135 inch inner diameter) spaced on a one-inch grid. Raindrops of approximately 2.5 mm diameter were generated for intensities ranging from 2 to 3-1/2 in/hr. The chamber was rotated in a small circle to prevent raindrop impact in the same locations. A 12 volt pump supplied water, regulated by a flowmeter, to the chamber from a 200 gallon polyethylene reservoir. The 200 gallon reservoir provided sufficient water for up to twelve runs per day. The apparatus is shown in Plate 4.2.

A wind screen consisting of a nylon reinforced plastic tarp suspended from a frame allowed operation of the simulator under windy conditions. The wind screen was taller than the rainfall simulator and completely encompassed it. An opening on one side allowed access for sampling during a run (Plate 4.3). The wind screen frame was separate from the rainfall simulator frame and was sufficiently sturdy to allow data runs in winds up to 20 mph. For high wind conditions, the bottom of the wind screen tarp was covered with dirt (Plate 4.4). Wind conditions in the study region required use of the wind screens every day. Complete design blueprints of the rainfall simulator, wind screen and accessories were prepared under a separate BLM work order.

Purified water was created by reverse osmosis (RO) and de-ionization (DI) filtration units. The raw tap water was first passed through the RO which reduced the EC from about 1,000 μmhos/cm to 100 μmhos/cm, and then through the DI tanks that produced a water quality less than 5 μmhos/cm. To remove the resins introduced by the DI tanks, the water was passed through a multimedia filter that included charcoal and diatomaceous earth and removed particles to 8 microns. The quality of the treated water was checked by daily pH and EC measurements and periodically a bottled sample was taken for chemical analysis.

4.2 Evaluation of Runoff and Water Quality Sampling Procedures

Accurate evaluation of water discharge and proper sampling for water quality analyses was an important factor in the field data collection process. Due to the anticipated low discharge and high sediment yield, discharge measuring flumes were not considered feasible. Therefore, volumetric sampling was used to define the water discharge hydrograph. The procedure involved evaluating the time required to fill a small container at different elapsed

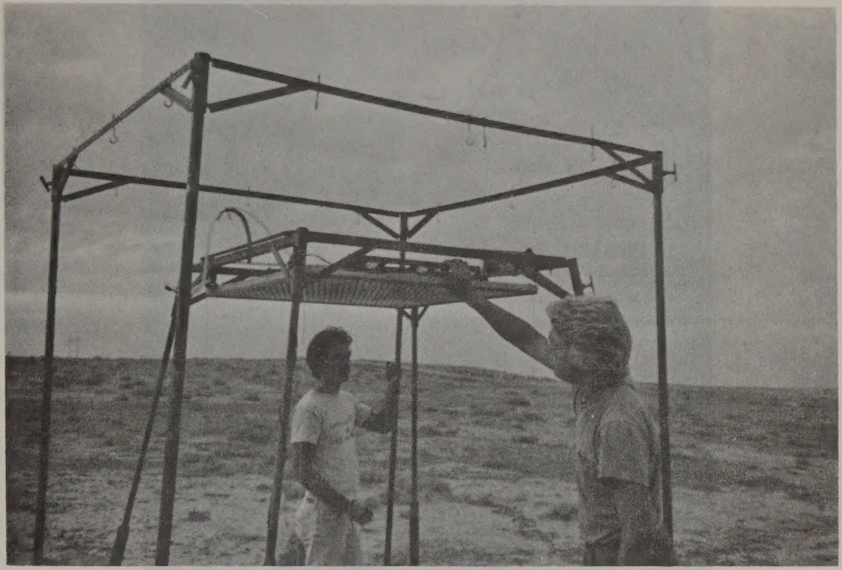


Plate 4.1. Rainfall simulator and frame for wind screen.

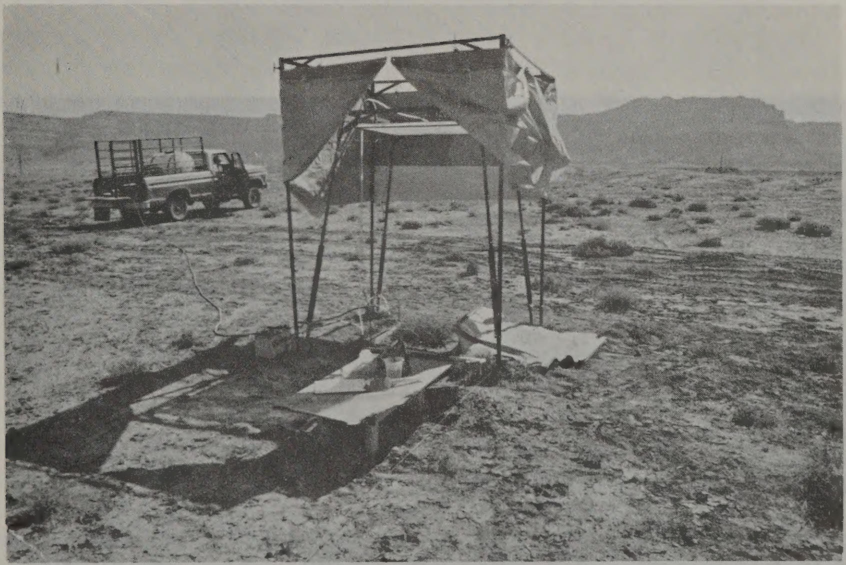


Plate 4.2. Rainfall simulator with wind screen. Note 200 gallon reservoir in truck, battery and pump.

Plate 4.3. Wind screen surrounding rainfall simulator.

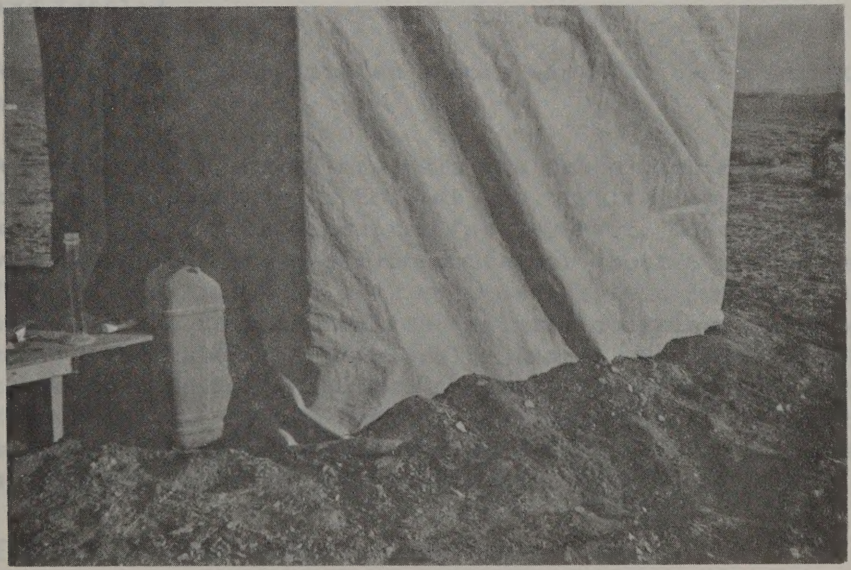


Plate 4.4. Covering the bottom of the wind screen tarp with dirt for high wind conditions.

time during the run. Graduated cylinders were used to accurately evaluate the volumes collected and stopwatches were used to determine the time to fill a container. A collector trough channeled the runoff from the test plot to a central collection point (Plate 4.5).

With small plot rainfall simulation it is feasible to collect the entire runoff from the experiment. A subsample of the entire runoff event provides an accurate estimate of the discharge weighted sediment yield. Two-quart containers were used to collect the entire runoff, since a large hole would have been required to place a six-gallon container under the outlet of the collector trough. As one two-quart container became full, it was removed and replaced by an empty one. The runoff collected in each two-quart container was poured into the six-gallon plastic container. Samples intercepted for volumetric evaluation of discharge were also poured into the six-gallon container. At the end of the run, the six gallon container was agitated by shaking and a one-liter sample was taken for laboratory analysis of sediment yield.

A second sample was taken from the entire runoff for chemical water quality analysis. The chemical water quality sample was filtered of all suspended sediment to prevent further reaction. The samples collected on any given day were put into a freezer at the end of the day and maintained in a frozen state until laboratory analysis. The maximum time delay between collection and placement in the freezer was eight hours. The step-by-step procedure for sampling involved:

1. Total runoff collected in 6-gallon plastic container. An aliquot of the unagitated sample was taken for EC measurement (Plate 4.6).

2. Each container was capped and vigorously shaken for approximately one minute to distribute sediment in the liquid.

3. Immediately after agitation, a sample for sediment yield analysis was taken by rapidly pouring into a one-liter Nalgene container via a wide-mouth funnel (Plate 4.7). The sample bottle was then capped and labeled.

4. An aliquot of the agitated sample was then taken for EC and pH measurement.

5. A sample for chemical analysis was taken with a filtering apparatus that removed particles to 0.45 μm. (Filter apparatus and filters are available from Geofilter Inc., Denver, Colorado.) The liquid was drawn from the 6-gallon container about 6 inches below the surface of the liquid by a 12 volt peristaltic pump, through the filter assembly and into a one-liter Nalgene container which was then capped and labeled (Plate 4.8). (Note: Since chemical analysis was to be done in Fort Collins, samples were frozen prior to transporting. Sample bottles were only filled to approximately 900 ml to allow for expansion due to freezing.) An aliquot of filtered sample was taken for pH measurement.

4.3 Resource Characterization of Study Plots

Resource characterization data were sampled for all plot types in all replications. The components measured included percent cover (vegetation,

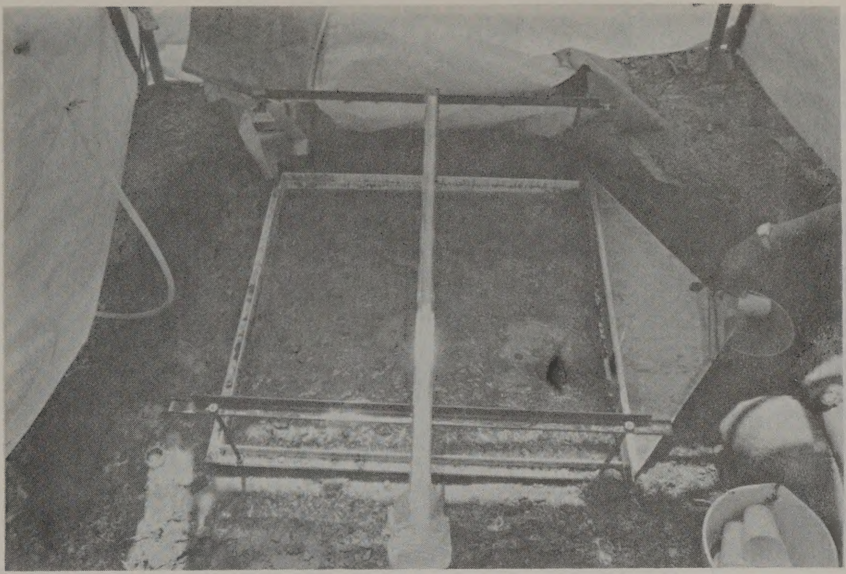


Plate 4.5. Plot frame and runoff collector trough with a sample about to be taken.

Plate 4.6. Measuring the EC of an aliquot of the total runoff.

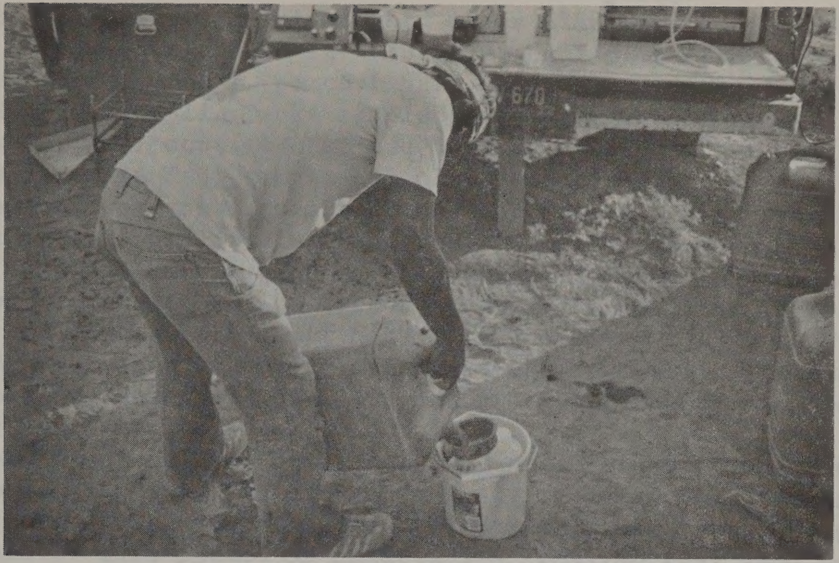


Plate 4.7. Collecting a one-liter sample for suspended sediment analysis from the total runoff.

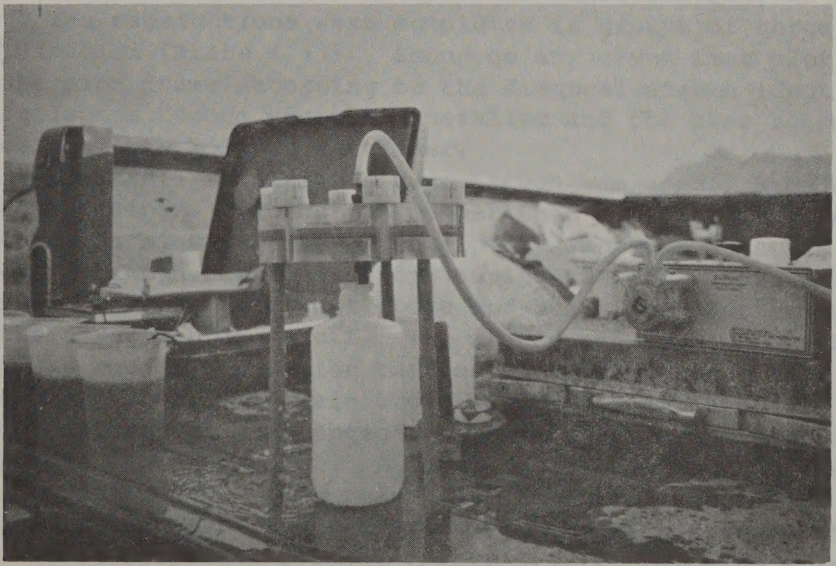


Plate 4.8. Filter apparatus used for collecting sample for chemical water quality analysis from the total runoff.

litter, rock), density, frequency, height, crown diameter, degree of mounding and percent of surface area disturbed due to trampling.

Density, frequency, plant height, crown diameter, and mounding measurements were obtained in a 6.25 ft^2 (30 x 30 inch) plot frame. Percent cover (vegetation, litter, rock), percent bare ground, and percent surface area disturbed due to trampling were sampled utilizing a grid frame. The grid frame (15 x 15 inch) consisted of one hundred 2.25 $inch^2$ (1.5 x 1.5 inch) cells and was designed to sample the plot in quadrants.

Two methods were used in obtaining data from the grid frame. The first, a point hit method, utilized a metal rod, or "pin", beginning in the upper left cell. The pin was lowered in the corner of every second cell along a row and every other row within the frame, producing a total of 25 points (or 25 percent of the plot). All first hits from the plant canopy to ground level were recorded for each of the 25 points in the quadrant. The frame was moved to each remaining quadrant until 100 points (100 percent) had been lowered and recorded (Plate 4.9).

The second method, the cell count, required counting components (i.e., cover, bare ground, etc.) in each of the 100 cells in the grid frame for each quadrant (Plate 4.10). Thus, every cell was equivalent to 0.25 percent of the total plot. This method of observation required that each component occupy the entire area of a cell to be recorded as "1". One-half of the cell was recorded as "0.5". Individual components were then averaged over the four quadrants to yield a percentage value for the plot. Crown cover was identified as normal foliage cover for each plant. Thus, the intraspacial foliage openings common to vegetative canopies were ignored, resulting in a somewhat large value for the cell count in relation to the point hit method for each measurement. However, useful comparisons can be made between data for these two sampling techniques.

4.4 Setup and Run Procedure

Three rainfall simulation crews operated simultaneously on the replication blocks. The replications were completed in groups of three, with one crew per replication (Plate 4.11). Setup on any given test plot was started by placing the plot frame according to the diagonal stakes identifying the plot. The collector trough was then installed and the area below excavated to allow placement of the 2-quart container.

To verify rainfall intensity a rain trough was used. Rain troughs are commonly used in rainfall simulation rather than circular-type rain gages. The rain trough was elevated above the plot by supports attached to the plot frame and moved through three positions during the run (Plate 4.12). The first and last positions were just above and below the plot frame, perpendicular to the direction of runoff. The middle position was in the center of the plot and was the only position that caused interference with the rainfall reaching the study plot. The rain trough was moved at 10-minute intervals; therefore, the effective interception was less than one percent of the total rainfall reaching the study plot. Rainfall collected in the rain trough flowed into a container for measurement at the end of the run.

The rainfall simulator was centered over the plot frame with plumb bobs and leveled with a carpenter's level (Plate 4.13). The wind screen frame was positioned and the tarp hung (Plate 4.14).

The test plot was covered with a tarp while the precipitation chamber filled with water. As the simulator began producing rainfall, all of the

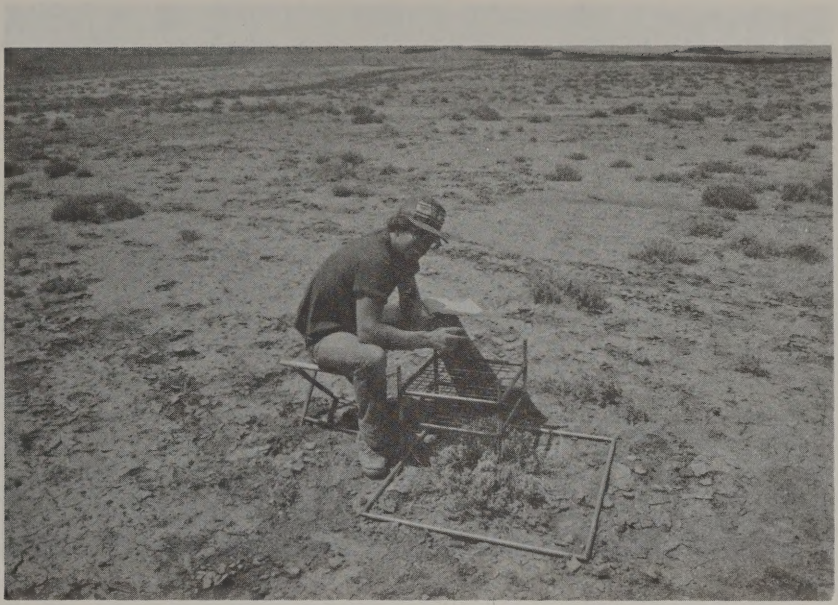


Plate 4.9. Point-hit method of resource characterization. The metal rod of pin is in the sampler's right hand.

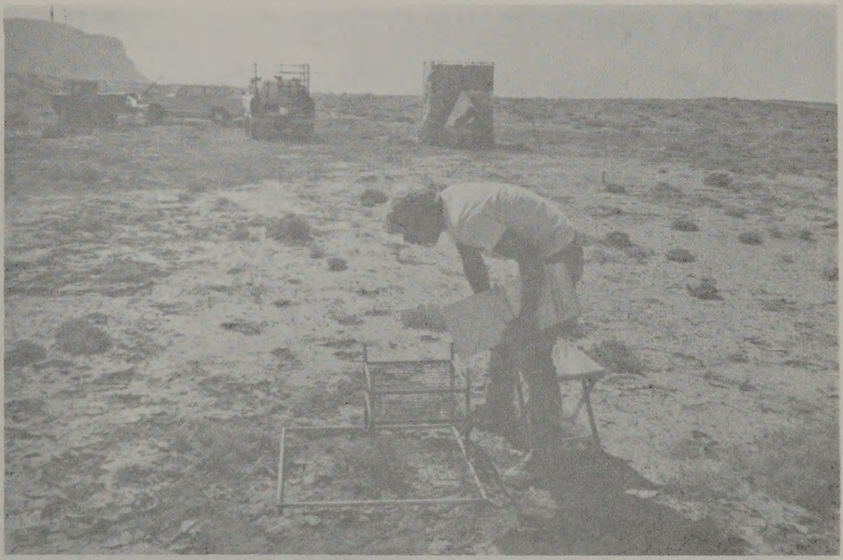


Plate 4.10. Cell count method of resource characterization.

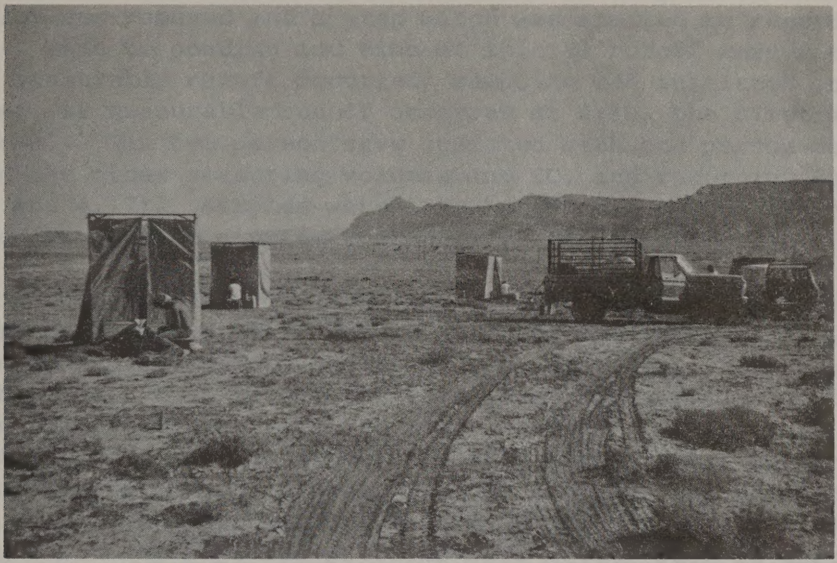


Plate 4.11. Three rainfall simulation crews operating simultaneously.

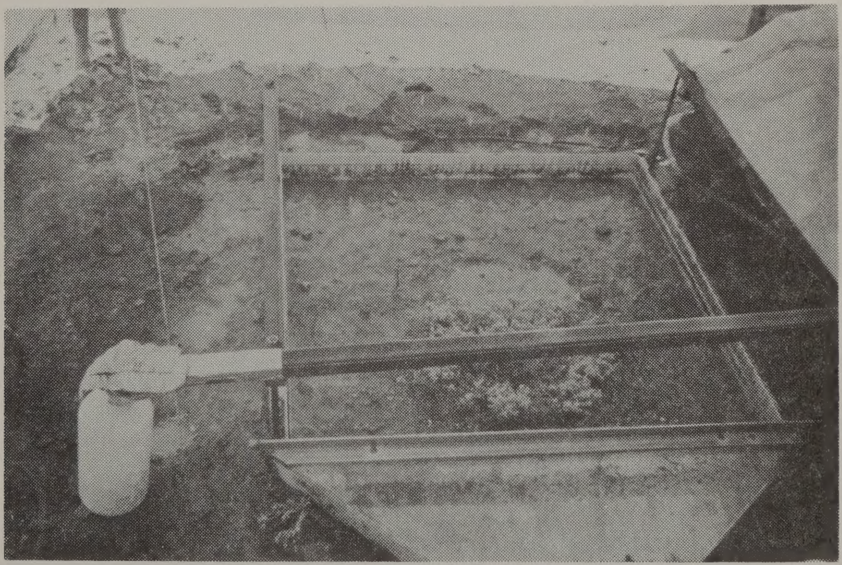


Plate 4.12. Rainfall trough for verifying rainfall intensity.

hypodermic tubes were checked to insure proper operation. After all hypodermic tubes were functioning and the rainfall intensity established, the cover over the plot was removed and a stop watch was started to record the beginning of the run. Time to ponding and time of initial runoff were recorded.

After measurable runoff occurred, sampling was initiated on the next full minute (i.e., if measurable runoff occurred at 2:30, the first sample would be taken at 3:00). The two person crew operated with one person collecting samples and the other measuring volumes and EC, and recording data (Plates 4.15, 4.16 and 4.17). Samples were taken every minute for the first eight minutes and every three minutes thereafter. Run duration was a minimum of 30 minutes.

After completion of a dry run, the wind screens were raised to allow the plots to dry to field capacity before starting the wet run (Figure 4.18). Field capacity was evaluated on-site by a simple test. When the soil could be molded by hand such that it did not feel moist, yet still held its shape, it was assumed that field capacity had been reached. Samples were taken for gravimetric analysis of soil moisture to verify the moisture condition prior to the start of the wet runs. A photograph of the plot was taken before and after each run. The photographs are in a separate document (SLA, 1981).

During a run any physical problems were noted, such as dust blowing under the wind screen, a "dam" formed by a hoofprint giving way and contributing water that had been ponded or any equipment problems. These observations were important, for example, since increased EC readings were often associated with dust and "dam" breaks. Other trends noted during the sampling included plot condition. Dry plots, plots with large bushes and heavily trampled plots generally delayed the initial time of runoff as compared to wet plots, bare plots and plots with no trampling.

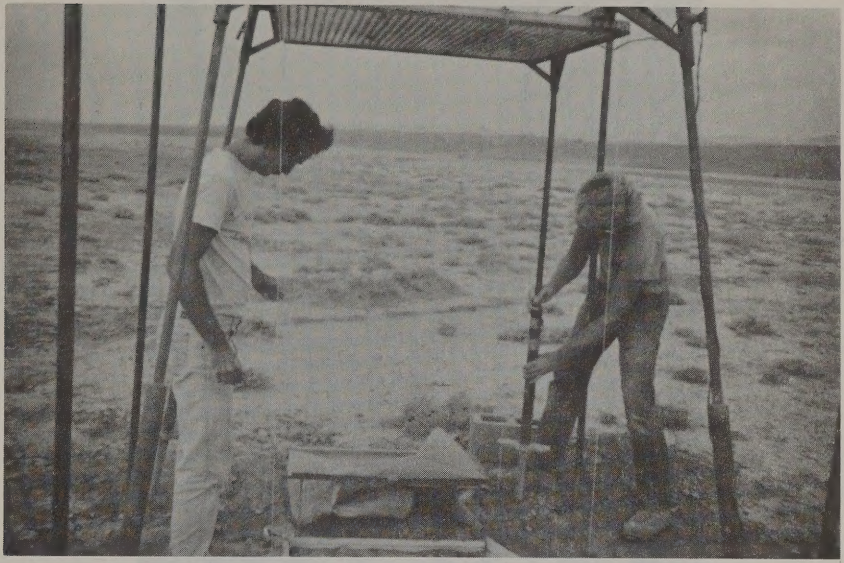


Plate 4.13. Centering and leveling the rainfall simulator over the study plot. Note plump bobs and adjustable jacks on support legs.

Plate 4.14. Hanging the wind screen tarp.

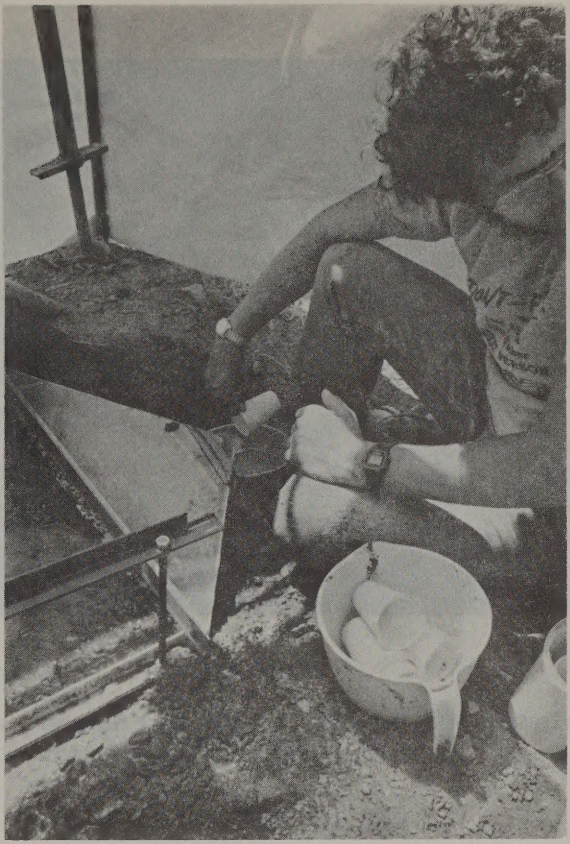


Plate 4.15. Preparing to collect a volumetric sample the evaluate runoff.

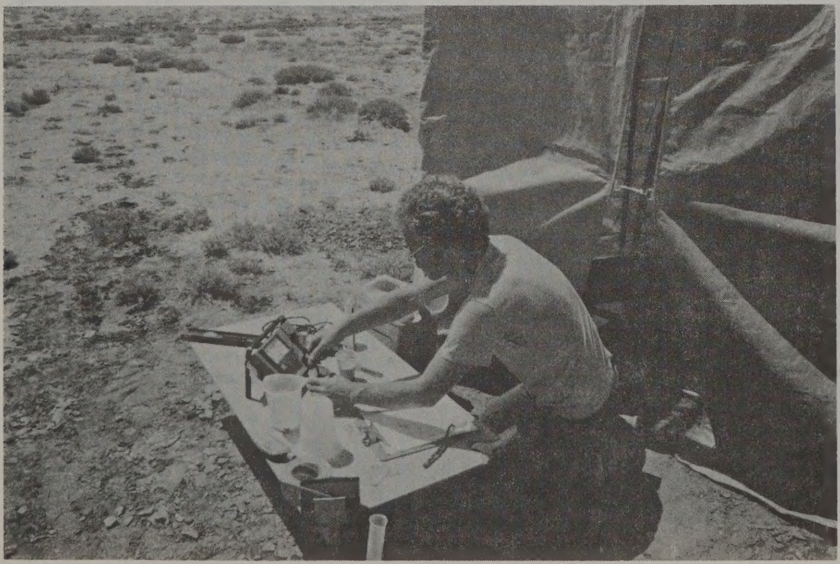


Plate 4.16. Evaluating the EC of the runoff sample.

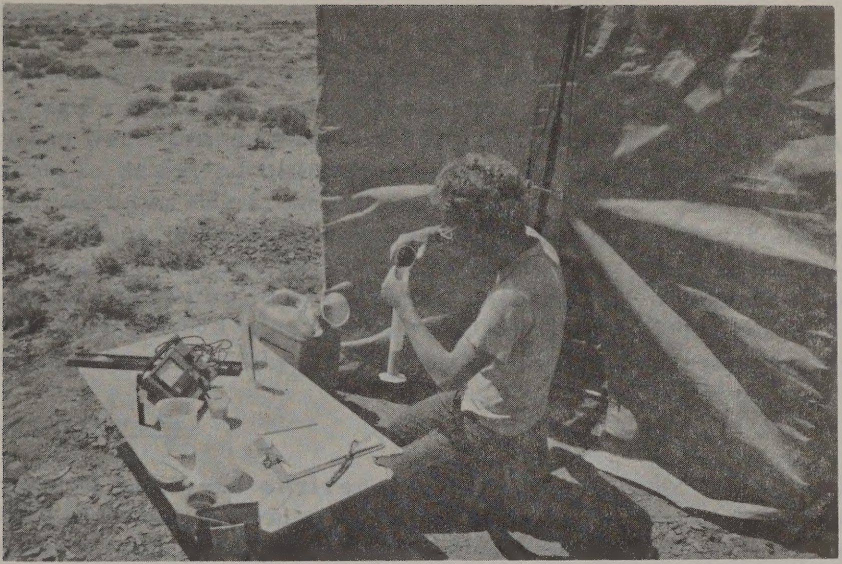


Plate 4.17. Measuring the volume of the sample collected for discharge evaluation.

Plate 4.18. Wind screen raised to allow plot to dry to field capacity prior to wet run.

V. SAMPLE ANALYSIS

5.1 Sediment Analysis

Samples collected for evaluation of sediment yield were sealed airtight and did not need refrigeration or freezing. At the end of the field season all the samples were transported to Fort Collins for analysis in the SLA sediment laboratory. Standard USGS procedures for gravimetric analysis of suspended sediment were followed (Guy, 1977).

Several samples developed colored supernatant, indicative of further interaction or leaching of sediment in the sample. Additionally, several had a strong hydrogen sulfide odor (H_2S) at the time of analysis, indicative of a sulfate reducing bacteria action (Desulfovibrio Desulfuricane). Neither of these reactions significantly affected the estimate of sediment yield.

5.2 Chemical Analyses

The chemical analysis evaluated runoff samples from each run to determine concentrations and measurements of 11 components. The samples were filtered at the field site and transported in the frozen state to the chemistry laboratory at Colorado State University. The laboratory procedures followed in the analysis were standard U.S. Geological Survey methods (Brown, et al., 1974). The components measured were electrical conductivity (EC), pH, total alkalinity (TA) as $CaCO_3$, total dissolved solids (TDS), fluoride (F^-), chloride (Cl^-), sulfate ($SO^=_4$), sodium (Na), Potassium (K), Calcium (Ca) and Magnesium (Mg). A general definition of each variable measured follows.

Electrical conductivity is a measure of the ability of the water to carry electric current and is an indication of ionic strength of the water. It is the reciprocal of specific resistance and is expressed in micromhos per centimeter (μmhos/cm) for most water. Freshly distilled water has a conductivity of 0.5 to 2 μmhos/cm. The conductivity of tap water in the Green River area ranged from 800 to 1000 μmhos/cm during the field data collection. Electrical conductivity is related to total dissolved solids by an empirical factor, $TDS = K(EC)$ where K ranges from 0.55 to 0.9 (American Public Health Association et al., 1981).

Total dissolved solids (TDS) are generally associated with fresh water systems and consists of inorganic salts, small amounts of organic matter and dissolved materials. Salinity is an oceanographic term and although not precisely equivalent to the total dissolved salt content, it is related to it (Capurro, 1970). The principal inorganic anions dissolved in water include carbonates, chlorides, sulfates and nitrates; the principal cations are sodium, potassium, calcium and magnesium. TDS is measured as mg/l or ppm.

The pH of water is a measure of the effective hydrogen-ion concentration. An overall normal range of pH is from 6 to 8. Natural waters are slightly basic ($pH<7$) due to the prevalence of carbonates in nature.

Total alkalinity as $CaCO_3$ is a measure of the hardness of water. Water is classified according to the presence of $CaCO_3$ below:

$CaCO_3$ mg/l	Classification
0 - 60	Soft
61 - 120	Moderately Hard
121 - 180	Hard
>180	Very Hard

Fluorides are generally present in most natural waters in small amounts. Natural fluorides are characteristic of waters from deep strata. Fluorides are introduced into water from insecticides, disinfectants and preservatives.

Chloride concentration varies widely in natural waters (1 mg/l to more than 2,000 mg/l). Chlorides are very soluble and the major anion in most brines in the U.S. Also human and animal wastes are high in chlorides.

Sulfate is leached from most sedimentary rocks. In natural waters, concentrations range from a few mg/l to thousands of mg/l.

Sodium salts are very soluble and are commonly found in soil and rocks. The sodium adsorption ratio (SAR) is the expression of relative activity of sodium ions in exchange reactions with soils and is an index of sodium or alkali hazard to the soil (Mundroff, 1972).

Potassium is abundant at the surface of the earth, but it is in a form not easily soluble. Therefore, potassium concentration measurements are generally less than 20 mg/l.

Calcium contributes to the hardness of water. It is dissolved from most rocks, but water near limestone areas contains concentrations of 30 to 100 mg/l whereas water near granite or siliceous sand may contain concentration less than 10 mg/l.

Magnesium is common at the surface of the earth. Water associated with granite and silicious sand may contain concentrations less than 5 mg/l whereas water associated with limestone may contain concentrations from 10-50 mg/l.

VI. TABULATION OF DATA

The extensive amount of data collected during the field study and subsequent laboratory analysis required detailed organization to effectively evaluate it. The data were grouped into six sets, consisting of field data, vegetation data, chemical data, soil moisture data, sediment concentration data and soil data. The data sets were retained on a magnetic computer tape for future analysis. The formatting of the data is described in the following sections. The data listings are presented in Appendix B.

The individual rainfall simulation runs are identified throughout the report by a four or five character run number. The first character identifies the replication (1-15), the second is the vegetative cover on the plot (B-bare, M-Mat, N-Nuttall), the third is the trampling level (1-none, 2-minimal, 3-moderate, 4-excessive) and the fourth is the soil moisture condition at the time of the run (D-dry, W-wet). Therefore, the run number 1B1D identifies a dry run on an untrampled, bare plot in the first replication.

6.1 Field Data

The field data presented here include the plot slope and the runoff characteristics from each rainfall simulation run. One file, "FLDDAT", was created to store this data. A total of twelve variables are tabulated for each run type. Eight of these variables are direct field measurements as listed below:

(1) EC1 - The electrical conductivity reading taken from a composite sample of runoff from each run, µmhos/cm.

(2) pH - The pH reading taken from a composite sample of runoff from each run.

(3) SLOP - The slope of the plot, percent rise over run.

(4) DR - The duration of the rainfall for each run, min.

(5) BRO - The time of the beginning of runoff, min.

(6) ERO - The time of the end of runoff, min.

(7) QP - The peak flow determined from field measurements, ml/sec.

(8) RFR - The rainfall rate for each run determined from field measurements, cm/hr.

The last four variables included in this file were calculated using the field measurements once the field work was completed. They are as follows:

(9) EC2 - The time-weighted average electrical conductivity value determined from the individual sample readings, µmhos/cm.

(10) VRO - The total volume of runoff for each run, determined from the individual sample flows, ml.

(11) RO - The amount of runoff computed from the VRO, inches.

(12) INF - The average infiltration rate, inches/hour.

A copy of this file has been provided in Appendix B, Table B.1.

6.2 Resources Characterization Data

The vegetation data was collected using both the point method and the cell count method (See Section 3.3). A single data file, "VEGDAT", contains the results from these two methods. Fifteen variables are tabulated for each plot type. These include six variables from the point-method as listed below:

(1) VEGP - The total vegetative cover on the plot, in percent.

(2) TLITP - The total litter cover on the plot, in percent. Total litter is defined to include three components: (1) total standing dead, (2) total standing dead biomass, and (3) undecomposed biomass lying on the surface of the ground.

(3) ROCKP - The total rock cover on the plot, in percent.

(4) TCOVP - The total cover on the plot which is the sum of the VEGP, TLITP and ROCKP, in percent.

(5) TBARP - the total amount of bare ground on the plot, in percent.

(6) DISP - The total disturbed bare ground on the plot, in percent.

Six variables resulting from the cell-count method included in "VEGDAT" are as follows:

(7) VEGC - The total vegetative cover on the plot, in percent.

(8) TLITC - The total litter cover on the plot, in percent.

(9) ROCKC - The total rock cover on the plot, in percent.

(10) TCOVC - The total cover on the plot which is the sum of VEGC, TLITC and ROCKC, in percent.

(11) TBARC - The total amount of bare ground on the plot, in percent.

(12) DISC - The total disturbed bare ground on the plot, in percent.

In addition to the twelve variables presented above, three variables were determined for each plot type. They include:

(13) DIA - The diameter of the plant present on the plot, inches.

(14) HEI - The height of the plant present on the plot, inches.

(15) MOV - The mounding category for the plot.

The mounding existing around each plant on a plot was divided into six classes which are defined as:

(i) A - no mounding present

(ii) B - less than or equal to one inch of mounding

(iii) C - from one to two inches of mounding

(iv) D - from two to three inches of mounding

(v) E - from three to four inches of mounding

(vi) F - greater than four inches of mounding

A listing of VEGDAT is given in Appendix B, Table B.2.

6.3 Soil Moisture Data

The soil moisture prior to each wet-run was determined in the field from soil samples taken between the dry and wet runs for each plot type. The samples were placed in Ziploc bags and were later gravimetrically analyzed for soil moisture content. Soil moisture by weight was based on an air-dry weight of the soil. The values are tabulated with all 15 replication soil moistures for a given plot type listed on one line. A copy of the file listing (SOILMST) has been included in Appendix B, Table B.3.

6.4 Sediment Concentration Data

A partial sample taken from the total runoff event for each runoff simulation run was used to evaluate sediment concentration (see Section 4.2). The one liter samples were gravimetrically analyzed using standard USGS procedures. The results of this analysis for each run type are stored in file "SEDCON". This data is listed for each plot type in Appendix B, Table B.4.

6.5 Chemical Data

The chemical analysis was based on a second partial sample taken from the total runoff event for each run. The one liter sample was filtered of all suspended sediment in the field, frozen and transported in the frozen state from the field to the laboratory (see Section 4.2).

Results obtained from the laboratory analysis were based on standard USGS procedures (see Section 5.2). The variables measured were electric conductivity (μmhos/cm), pH, total alkalinity (mg/l), total dissolved solids, F^-, Cl^-, $SO^=_4$, Na, K, Ca, Mg. The units for the chemical ions are all mg/l. The data are listed in file "CHMDAT" in Appendix B, Table B.5.

6.6 Soil Data

The soil data are comprised of two sets of data. Prior to the field season, one set was collected. BLM staff members sampled 18 sites for pH, electrical conductivity, calcium, magnesium, sodium absorption ratios and profiles to determine soil variability. During the field study, bulk density and soil moisture samples were taken on the north side of each replication.

The results of the chemical analysis for soil variability study are shown in Table B.6. The location of the sample sites were shown in Figure 3.2. Soil profile descriptions are in Table B.7. Table B.8 presents the results of the bulk density sample.

VII. DATA ANALYSIS AND RESULTS

7.1 General

Statistical analysis of the data was performed based on treatment levels and replications. A complete set of descriptive statistics was produced for the field, chemical, resource characterization, soil moisture and sediment concentration data. The descriptive statistics included means, standard deviations, and coefficients of skewness and variation. The next level of analysis involved two sample t-tests to determine if the differences between sample means were different from zero and at what significance level the two samples would be from the same population. Then an analysis of variance (ANOVA) was performed to establish the treatments which interacted and the treatments which affect the variation of a random variable.

Evaluation of the results of the t-test and results of the ANOVA allowed initial conclusions related to the hypotheses to be tested (Section 1.2). The final analyses were correlations between variables to establish dependence or independence. Regression relations were defined for infiltration rates and electrical conductivity readings as functions of plot characteristics.

7.2 Charactistic Statistics

7.2.1 Analysis Procedure

Means, standard deviations and coefficients of variation and skewness were calculated for the variables by run type, plot type, replication and trampling level. The arithmetic mean is the most common descriptor of central tendency and was used in calculating the sample statistic. The standard deviation is a measure of dispersion and is the square root of the variance. The standard deviation has the same dimension as the measured variable. The coefficient of variation is a dimensionless dispersion parameter and is defined as the ratio of the standard deviation to the mean. A knowledge of the coefficient of variation helps judge the success of an experiment. A small range with low values suggests the factors affecting the random variables were well controlled by the experimental procedure. The coefficient of skewness is a dimensionless measure of asymmetry and is defined as the ratio of the third central moment to the second central moment raised to the 3/2 power. The equations for the mean, standard deviation, coefficient of variation and coefficient of skewness are:

$$\text{Mean:} \quad \bar{x} = \frac{1}{N} \sum_{i=1}^{N} x_i \qquad (7.1a)$$

$$\text{Standard Deviation:} \quad s = +\sqrt{\frac{1}{N} \sum_{i=1}^{N} (x_i - \bar{x})^2} \qquad (7.1b)$$

Coefficient of Variation: $$C_v = \frac{s}{\bar{x}} \qquad (7.1c)$$

Coefficient of Skewness: $$C_s = \frac{m_3}{m_2^{3/2}} = \frac{m_3}{s^3} \qquad (7.1d)$$

where N is the number of sample values x_i, and m_2 and m_3 are the sample second and third moments, respectively.

The statistics calculated for all field data, sediment concentration data, resource characterization data, soil moisture data, and chemical data are presented in Appendices C through G. Hydrographs and infiltration curves are plotted by run type and presented in Appendices H and I, respectively. Infiltration rates were calculated from constant rainfall rates and measured discharges. Frequently, the calculated infiltration rate was 0.0 cm/hr. In two instances it was -0.2 cm/hr and in one instance it was -0.3 cm/hr. The statistical analyses were grouped by run type, plot type, replication numbers and trampling levels. The means and standard deviations of these data groups were calculated and are included in the corresponding tables.

The statistics calculated were used to evaluate trends and allow a visual inspection of inconsistencies. To evaluate trends, the groups of means were plotted and inspected. General trends in the means appeared between wet and dry groups of data and corresponded to different trampling level. The values of the second and third moments and coefficient of variation were visually inspected to see the range of values. Generally the values for one group appeared consistent among themselves.

7.2.2 Results for Field Data

Statistics were evaluated and graphical plots made for all variables in the field data file. The results discussed below focus on the main variables of interest: salinity as measured by electrical conductivity, peak runoff, volume of runoff and infiltration rate.

Electrical conductivity from the field data was measured in two ways as explained in Section 6.1. The total runoff sample and the time-weighted average sample produced the same trends. The total runoff sample registered slightly higher averages (481 μmhos/cm for dry runs and 422 μmhos/cm for wet runs) than the time-weighted average sample (399 μmhos/cm for dry runs and 341 μmhos/cm for wet runs). The reason for this can be attributed to the continued reaction of sediments in the total runoff sample over the run duration. In either case the average values were approximately one-half the values measured for tap water in the Green River area during the field season. For further comparison, the measured EC in the Green River at the gaging station near Green River, Utah, for the period October 1941 to September 1980 had a maximum daily value of 3250 μmhos/cm (December 1, 1967) and a minimum daily value of 255 μmhos/cm (June 30, 1978).

The tables with the means, standard deviations and coefficients of skewness and variation for the field variables are in Appendix C, Tables C.1 through C.60. The statistics are calculated for run types, plot types, replication number and trampling level.

For the electrical conductivity, the coefficient of variation ranges between 0.30 to 0.71. The large range in this coefficient, as compared to the others, is due to the nonhomogeneous nature of the salt-producing characteristics for a small plot. The coefficient of variation for other field data variables has a much smaller range. For example, the peak discharge which could be more readily regulated by plot size and rainfall rate has a coefficient of variation that ranges from 0.06 to 0.14.

7.2.3 Results for Resource Characterization Data

Statistics were evaluated and graphical plots made for all variables, except mounding, in the resource characterization data file. The results of certain measured variables are biased due to the way in which plots are defined. For example, percent disturbed is directly related to trampling level; percent vegetative cover and percent bare ground are related to the type of plot, i.e. bare, Mat or Nuttall.

The tables with means, standard deviations and coefficients of skewness and variation for the vegetation data are listed in Appendix D in Tables D.1 through D.42. The statistics were calculated for plot type, replication number and trampling level.

The coefficients of variation for the resource characterization data cover a wide range. This is due in part to the manner in which plots were selected. Also, the magnitude of the mean for a variable like rock cover from the point method is small (about 2-4 percent) and the standard deviation is of the same magnitude; this results in a relatively large coefficient of variation.

Generally, the means from the cell count method are 0.5 to 3.0 percent higher than the means from the point count method. This increase tends to lower the coefficient of variation for variables from the cell count method. Because the coefficient of variation for the measurements from the cell count method was lower, these measurements were used in developing regression relationships (Section 7.6).

7.2.4 Results for Soil Moisture Data

Soil moisture samples were taken between dry and wet runs to evaluate the consistency at which field capacity was reached prior to the wet run. The statistics for this variable are presented in Appendix E. Means, standard deviations and coefficients of skewness and variation were obtained. The graphical plots of the means indicated that the average moisture percentages were fairly uniform. Standard deviations are small, representing minimal variation.

The coefficient of variation for the soil moisture for all data groupings covers a small range, 0.05 to 0.12. This, along with the fact that the means cover a small range, 17.5 to 19.2, represents a fairly consistent wetted condition prior to the wet runs.

7.2.5 Results for Sediment Concentration Data

Sediment concentration was obtained for each run type. The statistics and graphical plots were completed for data groupings. Data were grouped by run type, plot type, replication number and trampling level. Tabulated statistics are in Appendix F, Tables F.1 through F.4.

Plots for these data indicated that an increase in sediment concentration corresponds to an increase in trampling level. When the data were grouped by vegetation there was a less noticeable trend.

Results of the statistical analysis for the sediment concentration show a fairly small range in the coefficient of variation with values from about 0.1 to 0.3. The magnitude of this coefficient of variation is greater than that observed in other cases. Most likely this is due to the variability in the measured sediment concentration as illustrated by the range of means in Table F.1.

7.2.6 Results for Chemical Data

Statistics and graphical plots by grouping were completed for the chemical data. The statistics are presented in Appendix G. The EC, pH, total alkalinity, total dissolved salts and measurements of chemicals characterized the salt production from the plot during each rainfall simulation. Observing graphical plots, salt production generally increased with trampling level. There was a noticeable increase in salt production when the results were grouped by vegetation type (Mat and Nuttall) and trampling level as compared to bare plots where no noticeable trend appears.

Sulfates were the most abundant chemical consituent (total mean 180.5 mg/l). Mundroff (1972) also found sulfate to be the most abundant chemical constituent in salt efflorescences. For comparison, during water year 1980 the average monthly sulfate concentration for the Green River at Green River, Utah, was 253 mg/l. The next most abundant chemical constituent in the rainfall simulation runoff was calcium with a total mean of 44.5 mg/l, followed by sodium, potassium, chloride, magnesium and fluoride. Total means for the latter five chemicals ranged from 5.5 to 0.18 mg/l. Comparativity, during water year 1980 for the Green River near Green River, Utah, the average monthly calcium concentration was 63 mg/l and the range for the other chemicals was from 110 to 0.2 mg/l. All chemical constituents, except chloride and sodium, appeared to increase with an increase in trampling level.

The coefficient of variation for the chemical variables was fairly large and often covered a relatively large range of values. The large range of values could be attributed to natural variation in soil composition, as previously suggested in the measured electrical conductivity.

7.3 Two Sample t-Test

7.3.1 Analysis Procedure

The statistics computed and summarized in the previous section were used to perform two sample t-tests. The purpose of this test is to determine at what significance level the means of two samples are from the same population. For this test, means from the expected extremes were compared. Three general types of comparisons were made. To establish that all replications were from the same population, or to determine at what significance level they could be assumed to be from the same population, the highest and lowest means from the statistics by replication were compared for dry and wet cases separately. A comparison between the mean from trampling levels one and four was made to determine if there was an effect on the variables due to trampling. The last comparison was made between the means of variables by trampling level and vegetation type. For this comparison, all the plots vegetated with mat saltbush at a certain trampling level were grouped together. The highest and lowest mean were then compared.

The test was performed for the means of the main variables of interest. These variables were electrical conductivity, peak runoff, runoff volume, infiltration rate, total alkalinity, sediment concentration, total dissolved solids, all ion concentrations and all resource characterization data.

The general procedure to perform two-sample t-tests is as follows. Two sample means, x_1 and x_2 from sample sizes of n_1 and n_2, with standard deviations s_1 and s_2, are selected. The test statistic is the difference between x_1 and x_2. The null hypothesis (H_o) is the assumption that the difference is not significantly different from zero. The significance level at which the null hypothesis is rejected is the probability that the decision is made to reject the null hypothesis and it is true. The pooled standard deviation, S_p, of the two samples is used in the test. The pooled standard deviation is from the following equation:

$$S_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)\, s_2^2}{n_1 + n_2 - 2}} \qquad (7.2)$$

The test is that the difference between $x_1 - x_2$ is within a range of values so:

$$\left| x_1 - x_2 \right| \leq +S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}\; t_{(1 - \frac{\alpha}{2},\, n_1 + n_2 - 2)} \qquad (7.3)$$

A test statistic to compare to the t-statistic in Equation 7.3 is:

$$\frac{\left| \bar{x}_1 - \bar{x}_2 \right|}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \leq t_{(1 - \frac{\alpha}{2},\, n_1 + n_2 - 2)} \qquad (7.4)$$

If Equation 7.4 is true, the null hypothesis is accepted for significance level α.

The results of the two sample t-tests will be presented by the type of comparison used. The tests made by replication will be first, followed by the tests according to trampling level and then trampling level and vegetation type.

7.3.2 Results for Two Sample t-Tests by Replication

Two sample t-tests by replication were used to compare the highest and lowest sample means. Table 7.1 shows the results of the test for the measured variables from the resource characterization data. The conclusion from this information is the sample means all represent the same population. The significance level ranges from 0.03 to 0.65 with an average about 0.2. The null hypothesis for the variables rock cover, total cover and percent bare from the point method and rock cover from the cell method is not rejected at a fairly

Table 7.1. Two Sample Test for Means by Replication
$H_o: x_1 - x_2 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\lvert \bar{x}_1 - \bar{x}_2 \rvert$	Test Statistic	H_o is not Rejected at $\alpha=$
	Lowest Mean $\bar{x}_1$	Highest Mean $\bar{x}_2$	Corresponding to $\bar{x}_1$	Corresponding to $\bar{x}_2$				
VEGP	6.3	11.7	5.6	9.77	8.0	5.4	1.7	0.10
TLITP	6.3	12.8	4.74	11.35	8.7	6.5	1.8	0.08
ROCKP	1.2	4.0	0.83	4.43	3.2	2.8	2.1	0.04
TCOVP	17.7	26.6	9.89	16.99	13.9	8.9	2.4	0.03
TBARP	73.4	82.3	16.99	9.89	13.9	8.9	2.4	0.03
DISP	22.3	26.8	23.22	25.03	24.1	4.5	0.4	0.65
VEGC	7.1	12.5	6.31	11.71	9.4	5.4	1.4	0.18
TLITC	7.1	12.7	4.38	10.44	8.0	5.6	1.7	0.10
ROCKC	2.6	4.6	1.32	3.01	2.3	2.0	2.1	0.05
TCOVC	20.0	28.2	11.12	17.39	14.6	8.2	1.4	0.18
TBARC	72.2	80.0	16.22	11.12	13.9	7.8	1.4	0.18
DISC	23.7	28.0	24.47	29.25	27.0	4.3	0.4	0.65
DIA	8.1	11.6	6.37	9.04	6.4	3.5	1.3	0.20
HEI	3.1	4.1	2.44	3.29	2.9	1.0	0.8	0.44

low significance level, indicating a larger variation in means for these measurements than the others; however, the significance level is still reasonable for field samples with natural variation.

Table 7.2 shows the result of the two sample t-tests for field data by replication for dry runs only. The results conclude that all samples are from the same population except for the peak runoff. The two-sample t-test is sensitive to the size of the pooled standard deviation, which for the peak runoff is small compared to the difference between the means.

Table 7.3 shows the results of the two-sample tests for field data by replication for wet runs only. In these cases the null hypothesis is always rejected. Based on the type of test being performed the reasons for this can be explained. The pooled standard deviation for the variables by replication for wet runs are from 11 to 42 percent less than the pooled standard deviation for dry runs. However, the difference between sample means is generally greater for wet runs than dry due to the natural variation within the site. Therefore, similar to the result for the dry run peak runoff discussed above, the pooled standard deviation is small compared to the difference in the means for all variables of the wet runs.

Tables 7.4 and 7.5 show the results of the two sample t-test by replication for chemical data for dry and wet runs, respectively. The results show enough variation between the two sample means to reject the null hypothesis and conclude the samples are from different populations for some variables. This is attributed to natural variation. Most variables are found to be from the same population with significance levels ranging from 0.01 to 0.28.

7.3.3 Results for Two Sample t-Tests by Trampling Level

The results of the two sample t-tests for sample means by trampling level are presented in this section. The results for the resource characterization data are shown in Table 7.6. The test indicates that the means for most variables at trampling levels 1 and 4 are from different populations. The reason for this is the effect trampling has on the measurements. For example, trampling would effect percent disturbed, so means from trampling level 1 and 4 would not be from the same population. But other measurements, such as percent of vegetative cover, were made initially for percent of vegetative cover that is disturbed or undisturbed. Slight trends are noticed in the data from visual inspection. Much less of the percent vegetative cover, rock or litter cover is in the disturbed portion of the sample. Reasons for this may be due to a lack of visibility of these particles once the plot is disturbed and an inherent tendency in cattle to avoid trampling on vegetation or large debris. But, the results do show an unexpected trend associated with trampling level for the resource characterization data.

The results of the two sample t-tests for the means of the field data by trampling level (Table 7.7) show no significant difference between the mean and normalized peak runoff at trampling levels 1 and 4 (significance levels of 0.04 and 1.0, respectively). This is a good indication that uniform flow had been reached at all trampling levels. Visual inspection of the plotted hydrographs verified this point even though the time to peak increased with increased vegetation covering and trampling. The sample means at trampling levels 1 and 4 for the remaining main variables from the field data, (electrical conductivity, volume of runoff, infiltration rate and sediment concentration) were not from the same population.

Table 7.8 shows the results of the two sample t-tests by trampling level for the chemical data. The results show that trampling causes significant

Table 7.2. Two Sample Test for Means by Replication for Dry Runs Only - $H_o: x_1 - x_2 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\overline{x}_1 - \overline{x}_2$	Test Statistic	H_o is not Rejected at $\alpha =$
	Lowest Mean $\overline{x}_1$	Highest Mean $\overline{x}_2$	Corresponding to $\overline{x}_1$	Corresponding to $\overline{x}_2$				
EC1	376	640	251	477	388.1	264	2.4	0.03
EC2	285	527	123	359	268.3	242	2.2	0.04
QP	8.2	9.6	0.8	1.13	0.98	1.4	3.5	Reject H_o
VOL	11,170	13,441	1,898	2,013	1,956	2,271	2.8	0.01
INF	0.79	1.11	0.38	0.26	0.33	0.32	2.4	0.03
SEDC	8,405	10,728	2,068	3,097	2,633.3	2,323	2.2	0.04

Table 7.3. Two Sample Test for Means by Replication for Wet Runs Only - $H_o: x_1 - x_2 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\lvert \overline{x}_1 - \overline{x}_2 \rvert$	Test Statistic	H_o is not Rejected at α=
	Lowest Mean $\overline{x}_1$	Highest Mean $\overline{x}_2$	Corresponding to $\overline{x}_1$	Corresponding to $\overline{x}_2$				
EC1	300	633	145	295	232.4	333	3.5	Reject H_o
EC2	242	514	112	253	195.6	272	3.4	Reject H_o
QP	8.6	10.0	0.5	0.64	0.57	1.4	6.0	Reject H_o
VOL	13,919	15,861	1,125	1,347	1,241.0	1,942	3.8	Reject H_o
INF	0.4	0.83	0.22	0.17	0.20	0.43	5.3	Reject H_o
SEDC	5,975	8,948	2,113	2,584	2,360	2,973	3.1	Reject H_o

Table 7.4. Two Sample Test for Means by Replication for Dry Runs Only - $H_o: x_1 - x_2 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\lvert \overline{x}_1 - \overline{x}_2 \rvert$	Test Statistic	H_o is not Rejected at $\alpha=$
	Lowest Mean $\overline{x}_1$	Highest Mean $\overline{x}_2$	Corresponding to $\overline{x}_1$	Corresponding to $\overline{x}_2$				
EC	341.0	684.3	157.8	460.9	344.5	343.3	3.45	Reject H_o
pH	7.6	8.3	0.5	0.4	0.45	0.7	5.39	Reject H_o
TA	16.21	21.54	4.07	1.97	3.20	5.33	5.77	Reject H_o
TDS	0.26	0.68	0.13	0.76	0.55	0.42	2.65	0.014
F^-	0.14	0.28	0.06	0.23	0.17	0.14	2.85	Reject H_o
Cl^-	2.38	8.19	1.95	17.44	12.41	5.81	1.62	0.12
$SO_4^=$	99.00	319.36	65.79	290.59	210.68	220.36	3.62	Reject H_o
Na	4.86	8.73	3.43	7.04	5.54	3.87	2.42	0.02
K	3.68	5.63	1.28	2.11	1.75	1.95	3.86	Reject H_o
Ca	37.39	71.53	16.87	41.38	31.60	34.14	3.74	Reject H_o
Mg	2.03	3.48	0.82	1.94	1.49	1.45	3.37	Reject H_o

Table 7.5. Two Sample Test for Means by Replication for Wet Runs Only - $H_o: x_1 - x_2 = 0$.

Variable	Mean Lowest Mean $\overline{x}_1$	 Highest Mean $\overline{x}_2$	Standard Deviation Corresponding to $\overline{x}_1$	 Corresponding to $\overline{x}_2$	Pooled Standard Deviation	$\overline{x}_1 - \overline{x}_2$	Test Statistic	H_o is not Rejected at α=
EC	285.0	581.7	151.2	281.8	226.1	296.7	4.55	Reject H_o
pH	7.8	8.1	0.7	0.6	0.65	0.3	1.60	0.12
TA	14.93	20.27	2.53	3.84	3.25	5.34	5.69	Reject H_o
TDS	0.23	0.49	0.22	0.36	0.30	0.26	3.00	Reject H_o
F^-	0.11	0.24	0.04	0.23	0.17	0.13	2.65	0.012
Cl^-	1.07	3.82	0.62	2.74	1.99	2.75	4.79	Reject H_o
$SO^=_4$	96.92	298.29	59.69	433.61	309.5	201.37	2.25	0.32
Na	2.34	5.90	1.80	5.50	4.09	3.56	3.02	Reject H_o
K	2.57	3.67	0.81	1.50	1.21	1.10	3.15	Reject H_o
Ca	31.53	54.35	16.96	33.25	26.39	22.82	3.00	Reject H_o
Mg	1.47	2.67	0.62	1.19	0.95	1.20	4.38	Reject H_o

Table 7.6. Two Sample Test for Means at Given Trampling Level
$H_o: x_1 - x_4 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\lvert \overline{x}_1 - \overline{x}_4 \rvert$	Test Statistic	H_o is not Rejected at α=
	Trampling Level 1, $\overline{x}_1$	Trampling Level 4, $\overline{x}_4$	Trampling Level 1	Trampling Level 4				
VEGP	11.3	7.6	9.55	7.28	8.5	3.7	2.9	Reject H_o
TLITP	11.1	6.8	6.27	5.53	5.9	4.3	4.9	Reject H_o
ROCKP	3.8	1.9	2.99	2.13	2.6	1.9	4.9	Reject H_o
TCOVP	26.2	16.2	12.13	10.79	11.5	10.0	5.8	Reject H_o
TBARP	73.8	83.8	12.13	10.77	11.5	10.0	5.8	Reject H_o
DISP	0.0	57.6	0.0	7.99	5.6	57.6	68.6	Reject H_o
VEGC	12.1	8.4	10.32	7.92	9.2	3.7	2.7	0.01
TLITC	10.9	7.9	5.80	5.26	5.5	3.0	3.6	0.01
ROCKC	4.9	3.5	2.72	2.18	2.5	1.4	3.7	0.01
TCOVC	27.9	19.8	12.41	11.38	11.9	8.1	4.5	0.01
TBARC	72.1	80.3	12.44	10.95	11.7	8.2	4.7	0.01
DISC	0.0	60.8	0.0	7.70	5.4	60.8	75.1	Reject H_o

Table 7.7. Two Sample Test for Means at Given Trampling Level $H_o: x_1 - x_4 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\lvert \overline{x}_1 - \overline{x}_4 \rvert$	Test Statistic	H_o is not Rejected at α=
	Trampling Level 1, $\overline{x}_1$	Trampling Level 4, $\overline{x}_4$	Trampling Level 1	Trampling Level 4				
EC1	331	577	173	348	274.8	246	6.0	Reject H_o
EC2	268	467	142	279	221.4	199	6.0	Reject H_o
QP	8.9	9.2	0.87	0.92	0.90	0.3	.8	0.4
NQP	1.4	1.4	0.15	0.17		0.0		1.
VOL	14,115	12,151	1,622	2,393	2,044.2	1,964	6.4	Reject H_o
INF	0.67	0.96	0.25	0.36	0.31	0.29	6.3	Reject H_o
SEDC	7,197	9,324	2,135	2,493	2,321	2,127	6.1	Reject H_o

Table 7.8. Two Sample Test for Means at Given Trampling Level $H_o: x_1 - x_4 = 0$.

	Mean		Standard Deviation					
Variable	Trampling Level 1, $\bar{x}_1$	Trampling Level 4, $\bar{x}_4$	Trampling Level 1	Trampling Level 4	Pooled Standard Deviation	$\lvert \bar{x}_1 - \bar{x}_4 \rvert$	Test Statistic	H_o is not Rejected at α=
EC	333.3	555.1	168.7	329.8	261.9	221.8	5.68	Reject H_o
pH	8.0	8.1	0.5	0.6	0.55	0.1	1.22	0.23
TA	16.55	17.54	2.97	3.00	2.99	0.99	2.22	0.04
TDS	0.25	0.45	0.14	0.29	0.23	0.20	5.83	Reject H_o
F^-	0.16	0.18	0.09	0.08	0.085	0.02	1.58	0.12
Cl^-	3.01	2.54	3.26	2.41	2.87	0.47	1.10	0.28
$SO_4^{=}$	124.07	248.57	81.17	220.54	166.17	124.50	5.03	Reject H_o
Na	4.97	5.04	3.93	4.70	4.33	0.07	0.11	1.
K	3.08	4.74	1.33	2.24	1.84	1.66	6.05	Reject H_o
Ca	34.66	54.83	18.71	31.60	25.97	20.17	5.21	Reject H_o
Mg	1.95	2.74	0.75	1.26	1.04	0.79	5.10	Reject H_o

difference between levels 1 and 4 for the electrical conductivity, total dissolved solids, sulfates, potassium, calcium and magnesium. No significant difference between the means of pH, total alkalinity, fluoride, chloride or sodium occurred at the two trampling levels. The level of significance ranges from 0.04 to 1.0.

7.3.4 Results for Two Sample t-Tests by Vegetation Type and Trampling Level

Tables 7.9 through 7.11 show the results of two sample t-tests by vegetation type and trampling level for the field data. The results show the means for peak runoff for all bare plots are in the same population, as are the means of peak runoff for mat saltbush plots and nuttall bush plots. The significance levels range from 0.01 for plots with mat saltbushes to 0.38 for plots with nuttal bushes. Since uniform flow was attained during the thirty minute duration rainfall simulation for all test conditions, this result is not unexpected.

For the other variables from the bare plots, the means for the time weighted average electrical conductivity and sediment concentration are from the same populations, whereas for the vegetated plots there is a significant difference in the mean of these variables (a significance level less than 0.01). This would indicate that trampling in combination with vegetation has a different effect on the sediment concentration and electrical conductivity of runoff.

Tables 7.12, 7.13 and 7.14 are the results of the two sample t-tests by vegetation type (bare, Mat and Nuttall) for the chemical data. Similar trends exist among the data sets. The difference between the most different sample means for chloride and sodium for all types of vegetative cover are not significant. For bare plots, the difference between the sample means for total alkalinity are significantly different from zero at $\alpha = 0.016$. For the plots with a nuttall bush, differences between sample means are significant for total alkalinity, fluoride or potassium at $\alpha = 0.34$, 0.6 and 0.014, respectively.

7.4 Analysis of Variance

7.4.1 Analysis Procedure

The experimental design represents a complete, factorial study because all possible combinations of factor levels for different factors are included. Also, this is a multifactor study because three or more factors are studied simultaneously. For this study, the factors are trampling level, vegetative cover and moisture condition.

The analysis of variance (ANOVA) is used to determine if the sample means for different factors are from the same population. It is useful in a preliminary inspection of experimental results and has many subsequent applications. For this analysis the preliminary results of the ANOVA are presented.

ANOVA was completed for the main variables of interest: (1) all variables for the resource characterization data, (2) all variables for the chemical analysis, (3) electrical conductivity from the field data, (4) peak runoff, (5) volume of runoff, (6) infiltration rate and (7) sediment concentration. The results of the ANOVA were summarized in tabular form. The information presented describes if the variation in the mean due to a certain factor is significant, and at what level. The other columns of the ANOVA

Table 7.9. Two Sample Test for Means by Trampling Level with Bare Cover $H_o: x_1 - x_2 = 0$.

Variable	Mean Lowest Mean $\overline{x}_1$	 Highest Mean $\overline{x}_2$	Standard Deviation Corresponding to $\overline{x}_1$	 Corresponding to $\overline{x}_2$	Pooled Standard Deviation	$\overline{x}_1 - \overline{x}_2$	Test Statistic	H_o is not Rejected at α=
EC1	320 B1	559 B3	174	369	288.5	239	3.2	Reject H_o
EC2	250 B1	375 B2	138	243	197.6	125	2.5	0.02
QP	9.0 B4	9.4 B2	0.9	0.79	0.85	0.4	1.8	0.08
VOL	12,470 B4	14,889 B1	2,587	1,605	2,152.7	2,419	4.4	Reject H_o
INF	0.49 B1	0.87 B4	0.21	0.37	0.30	0.38	6.6	Reject H_o
SEDC	7,783 B1	9,551 B3	2,508	2,917	2,720.2	1,768	2.5	0.02

Table 7.10. Two Sample Test for Means by Trampling Level with Mat Saltbush Vegetation $H_o: x_1 - x_2 = 0$.

Variable	Mean Lowest Mean $\bar{x}_1$	 Highest Mean $\bar{x}_2$	Standard Deviation Corresponding to $\bar{x}_1$	 Corresponding to $\bar{x}_2$	Pooled Standard Deviation	$\bar{x}_1 - \bar{x}_2$	Test Statistic	H_o is not Rejected at α=
EC1	357 M1	747 M4	195	402	315.9	390	4.8	Reject H_o
EC2	298 M1	592 M4	166	306	246.2	294	4.6	Reject H_o
QP	8.7 M4	9.4 M2	0.79	1.15	0.99	0.7	2.7	0.01
VOL	11,944 M4	14,077 M2	2,327	1,818	2,088.1	2,133	4.0	Reject H_o
INF	0.74 M2	1.00 M4	0.23	0.34	0.29	0.26	4.8	Reject H_o
SEDC	7,079 M1	10,020 M4	2,233	2,553	2,398.3	2,941	4.7	Reject H_o

Table 7.11. Two Sample Test for Means by Trampling Level with Nuttall Bush Vegetation $H_o: x_1 - x_2 = 0$.

Variable	Mean: Lowest Mean $\overline{x}_1$	Mean: Highest Mean $\overline{x}_2$	Standard Deviation: Corresponding to $\overline{x}_1$	Standard Deviation: Corresponding to $\overline{x}_2$	Pooled Standard Deviation	$\lvert \overline{x}_1 - \overline{x}_2 \rvert$	Test Statistic	H_o is not Rejected at α=
EC1	314 N1	544 N4	149	336	259.9	230	4.8	Reject H_o
EC2	258 N1	452 N4	117	277	212.6	194	4.9	Reject H_o
QP	8.8 N4	9.0 N3	0.92	0.89	0.91	0.2	1.2	0.24
VOL	12,039 N4	13,843 N1	2,304	1,506	1,946.3	1,804	5.0	Reject H_o
INF	0.73 N1	1.01 N4	0.25	0.37	0.32	0.28	4.8	Reject H_o
SEDC	6,728 N1	8,564 N4	1,456	2,632	2,126.9	1,836	4.6	Reject H_o

Table 7.12. Two Sample Test for Means by Trampling Level with Bare Cover $H_o: x_1 - x_2 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\lvert \bar{x}_1 - \bar{x}_2 \rvert$	Test Statistic	H_o is not Rejected at α=
	Lowest Mean $\bar{x}_1$	Highest Mean $\bar{x}_2$	Corresponding to $\bar{x}_1$	Corresponding to $\bar{x}_2$				
EC	336.3 B1	621.6 B3	172.9	398.3	307.0	285.3	3.60	Reject H_o
pH	7.6 B2	8.0 B1	0.4	0.5	0.45	0.4	3.44	Reject H_o
TA	14.73 B1	16.31 B4	1.89	2.89	2.44	1.58	2.51	0.016
TDS	0.25 B1	0.58 B3	0.13	0.56	0.41	0.33	3.12	Reject H_o
F^-	0.14 B2	0.29 B3	0.04	0.30	0.21	0.15	2.77	Reject H_o
Cl^-	1.36 B2	2.37 B3	1.51	3.39	2.62	1.01	1.49	0.14
$SO_4^=$	125.42 B1	239.65 B3	76.80	211.60	159.17	114.23	2.78	Reject H_o
Na	1.60 B1	5.02 B3	0.69	7.94	5.64	3.42	2.35	0.24
K	2.23 B1	3.93 B4	1.13	2.31	1.82	1.70	3.62	Reject H_o
Ca	37.34 B1	59.90 B3	18.42	38.48	30.17	22.56	2.90	Reject H_o
Mg	1.71 B1	2.80 B3	0.64	1.21	0.97	1.09	4.35	Reject H_o

Table 7.13. Two Sample Test for Means by Trampling Level with Mat Saltbush Vegetation $H_o: x_1 - x_2 = 0$.

Variable	Mean		Standard Deviation		Pooled Standard Deviation	$\lvert \bar{x}_1 - \bar{x}_2 \rvert$	Test Statistic	H_o is not Rejected at α=
	Lowest Mean $\bar{x}_1$	Highest Mean $\bar{x}_2$	Corresponding to $\bar{x}_1$	Corresponding to $\bar{x}_2$				
EC	348.8 M1	708.5 M4	175.9	375.8	293.4	359.7	4.75	Reject H_o
pH	7.5 M2	8.3 M4	0.4	0.7	0.57	0.8	5.44	Reject H_o
TA	19.78 M2	18.46 M3	2.18	3.02	2.63	2.68	3.95	Reject H_o
TDS	0.25 M1	0.59 M4	0.14	0.36	0.27	0.34	4.88	Reject H_o
F^-	0.14 M1	0.20 M4	0.05	0.06	0.055	0.06	4.23	Reject H_o
Cl^-	2.91 M4	3.80 M1	2.40	2.36	2.38	0.89	1.45	0.16
$SO^=_4$	127.02 M1	306.14 M4	80.22	216.28	163.11	179.12	4.25	Reject H_o
Na	5.54 M2	6.87 M3	4.44	3.97	4.21	1.33	1.22	0.23
K	3.33 M2	5.73 M4	1.55	2.38	2.01	2.40	4.62	Reject H_o
Ca	35.96 M1	64.73 M4	19.46	29.45	24.96	28.77	4.46	Reject H_o
Mg	2.01 M1	3.15 M4	0.77	1.64	1.28	1.14	3.45	Reject H_o

Table 7.14. Two Sample Test for Means by Trampling Level with Nuttall Bush Vegetation $H_o: x_1 - x_2 = 0$.

	Mean		Standard Deviation					
Variable	Lowest Mean $\overline{x}_1$	Highest Mean $\overline{x}_2$	Corresponding to $\overline{x}_1$	Corresponding to $\overline{x}_2$	Pooled Standard Deviation	$\lvert \overline{x}_1 - \overline{x}_2 \rvert$	Test Statistic	H_o is not Rejected at α=
EC	314.9 N1	526.5 N4	161.0	316.0	250.78	211.6	3.27	Reject H_o
pH	7.8 N2	8.2 N1	0.5	0.5	0.5	0.4	3.10	Reject H_o
TA	17.76 N1	18.74 N2	3.25	4.37	3.85	0.98	0.99	0.34
TDS	0.25 N2	0.40 N4	0.17	0.23	0.20	0.15	2.90	Reject H_o
F^-	0.17 N3	0.20 N2	0.05	0.13	0.10	0.03	1.16	0.26
Cl^-	3.36 N4	5.82 N5	2.80	10.40	7.62	2.46	1.25	0.20
$SO_4^=$	119.78 N1	202.66 N4	88.65	137.51	115.69	82.88	2.77	Reject H_o
Na	6.57 N4	8.55 N3	4.22	6.50	5.48	1.98	1.40	0.17
K	3.39 N1	4.78 N2	1.10	2.79	2.12	1.39	2.54	0.014
Ca	30.70 N1	54.91 N4	18.18	35.97	28.50	24.21	3.29	Reject H_o
Mg	2.13 N1	2.77 N4	0.78	0.90	0.84	0.64	2.95	Reject H_o

table describe the possible combinations of interaction between and among the factors and at what significance level interaction would occur. If interactions do exist between or among factors, the corresponding table of means should be examined to determine if one factor is the cause of the observed interactions. The ANOVA was performed for the main variables by combining all factor levels. The ANOVA for all factors comprised a three factor study. The factors for field and chemical data were trampling level, vegetation cover and moisture condition. The ANOVA for the resource characterization data was a two factor study. The factors were trampling level and vegetative cover.

7.4.2 Results of the ANOVA

Table 7.15 shows the significance level at which variation or interaction would occur for the resource characterization data. A significance level near five percent or even one percent is acceptable for experimental data. A signficance level much greater than 0.1 indicates the mean for that set of factors is well within the accepted range. A significance level much less than 0.005 indicates the means of different factor levels are most likely not from the same population. The summary table shows no interaction between trampling and vegetation factors except for percent disturbed (DISC) at a 0.04 significance level. Generally, the means for the vegetation and trampling level factors are not from the same population.

Table 7.16 is the ANOVA summary for the main field data variables of interest and sediment concentration measurements. There may be interaction between the factors affecting the measurements of electrical conductivity, runoff volume and infiltration; however, it is more likely the interaction indicated is due to the variation in the means for the trampling, moisture and vegetation factors alone. The greatest variability in the mean for all variables except electrical conductivity is due to moisture conditions. The factor with the greatest variation contributing to the means for electrical conductivity is trampling level. After the moisture factor, the trampling level affects the means of volume, infiltration and sediment concentration. Trampling level does not affect the peak runoff at a significance level of 0.05 because uniform flow had been reached during the duration of the rainfall simulation for the small plot experiments.

Results of the ANOVA for the chemical data, Table 7.17, show trampling significantly (the significance level is less than 0.04) contributes to variation in the mean of all chemical variables except Cl^-. Moisture content of the soil prior to the run contributes to the variation of the mean for most of the chemical variables; pH and $SO^=_4$ are excluded when the significance level is less than 0.02.

Statistically, the variation in the means attributed to trampling, vegetation and moisture condition was significant, and the large deviation from the means is most likely creating the interaction between certain factors for some of the chemical data.

The next step in analyzing the results of the ANOVA is to evaluate the performance of other tests which examine the class means and the sizes of differences among them. Examples of these types of tests are Least Significant Difference (LSD), Tukey's method (which is similar to the Q method), Duncan test or Scheffe's method. Each test has unique advantages and disadvantages. The ANOVA tables are presented in Appendix K.

Table 7.15. Summary of ANOVA Results for All Factor Resources Characterization Data

	Significance Level, α, for Given Factors						
Variable	R,T,V	R,T	R,V	R	T,V	T	V
VEGP	x	x	x	x	x	x	VAR
TLITP	x	x	x	x	x	.02	.01
ROCKP	x	x	x	x	x	.001	.01
TCOVP	x	x	x	x	x	.005	VAR
TBARP	x	x	x	x	x	.005	VAR
DISP	x	x	x	x	x	VAR	x
VEGC	x	x	x	x	x	x	VAR
TLITC	x	x	x	x	x	.09	VAR
ROCKC	x	x	x	.06	x	.02	.01
TCOVC	x	x	x	x	x	.04	VAR
TBARC	x	x	x	x	x	.035	VAR
DISC	x	x	x	x	x	VAR	x
DIA	x	x	x	x	x	x	VAR
HEI	x	x	x	x	x	x	VAR

R = Replication
T = Trampling
V = Vegetation

x = $\alpha >> 0.10$
VAR = $\alpha << 0.001$

Table 7.16. Summary of ANOVA Results for All Factor Field Data.

	Significance Level, α, for Given Factors														
Variable	R,T,V,M	R,T,V	R,T,M	R,T	R,V,M	R,V	R,M	R	T,V,M	T,V	T,M	T	V,M	V	M
QP	x	x	x	x	x	x	x	VAR	x	x	x	.075	x	.004	VAR
NQP	x	x	x	x	x	x	x	VAR	x	x	x	x	x	VAR	VAR
VOL	x	x	x	x	x	x	x	.004	x	x	.03	VAR	x	VAR	VAR
EC1	x	.01	x	INT	x	.04	x	.01	x	.001	x	VAR	x	x	.06
EC2	x	.003	x	.001	x	.03	x	.007	x	.003	x	VAR	x	x	.02
INF	x	x	x	x	x	x	x	.004	x	x	.001	VAR	x	VAR	VAR
SED	x	x	x	.065	x	.05	x	.01	x	x	x	VAR	x	.015	VAR

R = Replication
T = Trampling
V = Vegetation
M = Moisture

x = $\alpha >> 0.10$
VAR = $\alpha << 0.001$
INT = $\alpha << 0.001$

Table 7.17. Summary of ANOVA Results for All Factor Chemical Data.

	Significance Level, α, for Given Factors														
Variable	R,T,V,M	R,T,V	R,T,M	R,T	R,V,M	R,V	R,M	R	T,V,M	T,V	T,M	T	V,M	V	M
EC	x	.001	x	.005	x	x	x	.001	x	.01	x	VAR	x	x	.025
pH	x	x	x	INT	x	x	x	x	x	.06	x	VAR	x	x	x
TA	x	.02	x	.06	x	x	x	.001	x	x	x	.06	x	VAR	VAR
TDS	x	.05	x	.01	x	x	x	.001	x	.01	x	VAR	x	x	.025
Fl^-	x	x	x	.025	x	x	x	.01	x	INT	x	.08	x	x	.02
Cl^-	x	x	x	x	x	x	x	x	x	x	x	x	INT	VAR	VAR
$SO_4^=$	x	INT	x	.1	x	x	x	.001	x	.05	x	VAR	x	x	x
Na	x	.02	x	.025	x	x	x	x	x	x	x	.04	x	VAR	VAR
K	x	x	x	x	x	x	x	x	x	.03	x	VAR	x	VAR	VAR
Ca	x	.001	x	.001	x	.05	x	.015	x	.02	x	VAR	x	x	.025
Mg	x	x	x	.01	x	.075	x	.001	x	.03	x	VAR	x	x	VAR

R = Replication
T = Trampling
V = Vegetation
M = Moisture

x = $\alpha >> 0.10$
VAR = $\alpha << 0.001$
INT = $\alpha << 0.001$

7.5 Correlation Analysis

7.5.1 Analysis Procedure

The correlation coefficient can be used to test if two variables are linearly dependent or independent and correlated or uncorrelated. The correlation coefficient is defined as the ratio of the covariance to the square root of the product of variances of the two components. The covariance is defined as

$$\mathrm{COV}\ (x,y) = S_{xy} = \frac{1}{N} \sum_{i=1}^{N} (x_i - \bar{x})\ (y_i - \bar{y}) \tag{7.5}$$

The dimensionless correlation coefficient is then

$$\rho = \frac{S_{xy}}{(\mathrm{Var}\ x \cdot \mathrm{Var}\ y)^{1/2}} = \frac{S_{xy}}{S_x\ S_y} \tag{7.6}$$

The limits of ρ are plus or minus one with a value of zero for independent events.

The correlation coefficient is considered significantly different from zero at the one percent level if it is 0.33 or greater when $n = 60$. At the 5 percent significance level, the correlation coefficient should be 0.25 or greater to be considered different from zero when $n = 60$. The null hypothesis, $H_o{:}r=0$, is rejected if the following equation is true.

$$\frac{r\sqrt{n-2}}{\sqrt{1-r^2}} > t_{1-\frac{\alpha}{2},\ n-2} \tag{7.7}$$

where

r = correlation coefficient
n = number of sample variables
t = Student t-statistic at significance level α with n-2 degrees of freedom

7.5.2 Results of Correlation Analysis

Tables 7.18 to 7.20 present the results of the correlation analysis by vegetation type. The data for Table 7.18 includes all bare plots. The variables being considered are grouped into dry and wet run categories, Tables 7.19 and 7.20 are for plots with Mat and Nuttall bushes, respectively, and the variables being considered are grouped into dry and wet run categories.

The results of the correlation analyses show electrical conductivity and total dissolved solids to be highly correlated for wet and dry runs and all types of vegetation cover (correlation coefficients range from 0.76 to 0.97). Electrical conductivity measurements for both field samples and chemical analyses are highly correlated and linearly dependent.

Table 7.18. Correlation Coefficents for Data From Bare Plots.

		Dry Runs					Wet Runs				
		EC2	EC	TDS	SED	VOL	EC2	EC	TDS	SED	VOL
BARC		.24	.16	.07	.29	-.27	.20	.25	.27	.08	-.23
DISTC		.14	.11	.10	.44	-.61	.18	.18	.23	.12	-.38
Dry Runs	EC2		.92	.76	.23	-.06					
	EC			.83	.16	-.07					
	TDS				.12	-.04					
	SED					-.02					
Wet Runs	EC2							.89	.82	.32	.02
	EC								.95	.33	-.05
	TDS									.30	-.08
	SED										.27

Table 7.19. Correlation Coefficents for Data From Plots with Mat Saltbushes.

		Dry Runs					Wet Runs				
		EC2	EC	TDS	SED	VOL	EC2	EC	TDS	SED	VOL
BARC		.29	.30	.28	.49	.15	.32	.31	.31	.47	.24
DISTC		.46	.47	.49	.52	-.64	.39	.38	.44	.30	-.32
Dry Runs	EC2		.96	.93	.45	-.35					
	EC			.97	.47	-.33					
	TDS				.45	-.35					
	SED					-.17					
Wet Runs	EC2							.99	.97	.44	-.12
	EC								.97	.46	-.13
	TDS									.43	-.14
	SED										.12

Table 7.20. Correlation Coefficents for Data From Plots with Nuttall Bushes.

		Dry Runs					Wet Runs				
		EC2	EC	TDS	SED	VOL	EC2	EC	TDS	SED	VOL
BARC		.15	.19	.19	.34	.10	.22	.25	.20	.31	-.07
DISTC		.36	.38	.30	.36	-.58	.36	.33	.31	.34	-.24
	EC2		.94	.85	.22	-.01					
Dry	EC			.92	.26	.00					
Runs	TDS				.14	.01					
	SED					.07					
	EC2							.96	.92	.30	-.07
Wet	EC								.96	.37	-.03
Runs	TDS									.35	.03
	SED										.35

Sediment concentration and total dissolved solids were most correlated for the Mat saltbush vegetation cover with a correlation coefficient of 0.45 for dry runs and 0.43 for wet runs. For the bare plots, the correlation coefficient was 0.12 and 0.30 for the dry and wet runs, respectively. The correlation coefficient between sediment concentration and total dissolved solids for the nuttall bush plot type was 0.14 for dry runs and 0.35 for wet runs. The correlation is fairly low but with small plots there would be natural variation expected and variation due to other factors.

Plot runoff volumes are linearly independent and not significantly correlated with total dissolved solids except for the dry runs with Mat salt bushes where the correlation coefficient is -0.35. Total dissolved solids are correlated with electrical conductivity as previously mentioned. However, electrical conductivity is significantly correlated with sediment concentration (the correlation coefficient is greater than 0.25) except for dry runs on bare plots. Therefore, sediment concentration, electrical conductivity and total dissolved solids all represent salt content but are generally independent of the runoff volume. This may indicate that a large amount of evaporites are influencing the total dissolved solids and electrical conductivity measurements, especially since electrical conductivity is more closely correlated with total dissolved solids during the wet run.

Percent bare soil and percent disturbed are both significantly correlated with sediment concentration where the correlation coefficient is greater than 0.25 except for bare plots when the correlation during wet runs is less significant.

Percent disturbed is correlated with volume of runoff and the variables are inversely related with a correlation coefficient ranging from -0.24 to -0.64. A lower correlation exists between percent disturbed and volume of runoff for wet runs than for dry runs. Once the plot is wet, the infiltration rate is reduced and runoff increases. These results are based on small plot simulation. Trampling and vegetation cover effects may have greater variation or significance on a larger site due to the greater change in time to peak as compared to small areas.

7.6 Multiple Regression Relationship

7.6.1 Analysis Procedure

The purpose of the multiple regression analysis was to determine if various degrees of trampling induce predictable changes in the salinity production and infiltration rates of Mancos Shale-derived soils. For this reason, multiple regression relations were developed to define electrical conductivity (EC) and infiltration rates as a function of resource characterization data. A relationship was defined for each moisture condition and vegetation type resulting in six multiple regression equations for both EC and infiltration rates. The regression relationships were of the general form:

$$Y = a + b_1 x_1 + b_2 x_2 + \ldots + b_k x_k \tag{7.8}$$

Numerous multiple regressions were determined for EC and infiltration rates as functions of different combinations of the resource characterization data and plots. Acceptable regressions were based on the coefficient of multiple determination being significantly different from zero, regression coefficients being significantly different from zero, and the information content of the regression as determined by the ANOVA table for the regression. Then, a plot of the standardized residuals versus each of the independent variables was made to check that no trends existed in the residuals.

7.6.2 Results

The multiple regression equations derived for EC and infiltration are given in Appendix J. The first step in establishing acceptable regressions was evaluation of the coefficient of multiple determination. The coefficient of multiple determination (R^2) is the square of the multiple correlation between the sample, independent variables and the corresponding, predicted dependent variables, and it represents the percent of the variation in the dependent variable that can be explained by the multiple regression equation. To determine if the R^2 is significantly different from zero (i.e., the regression equations are significant), an F-test of the null hypothesis, $H_o: R^2=0$ is used. The null hypothesis is rejected if the following equation is true:

$$\frac{(n - k - 1)\ R^2}{k(1 - R^2)} > F_{1 - \alpha,\ k,\ n - k - 1} \qquad (7.9)$$

where

R^2 = coefficient of multiple determination
n = number of sample variables
k = number of independent variables in regression
$F_{1 - \alpha,\ k,\ n - k - 1}$ = F-statistic at significance level of α and $k,\ n - k - 1$ degrees of freedom

Analysis of the coefficient of multiple regression showed R^2 to be significantly different from zero for all cases at the five percent level and most cases at the 1.0 to 2.5 percent level.

The next test was to determine if the regression coefficients were significantly different from zero based on the t-test. The test statistic is determined by dividing the regression coefficient by the standard deviation of the regression coefficient. If the following statement is true, the null hypothesis, $H_o: a=b_1=b_2, \ldots b_k=0$, is rejected:

$$\frac{b_i}{S_{b_i}} > t_{1 - \frac{\alpha}{2},\ n - k - 1} \qquad (7.10)$$

where

b_i = regression coefficient for dependent variable i where $i = 1, \ldots, k$
S_{b_i} = standard deviation of regression coefficient, b_i
$t_{1-(\alpha/2),\ n-k-1}$ = t-statistics at significance level of α with n-k-1 degrees of freedom
n = number of sample values

The results of the test showed all regression coefficients to be significantly different from zero at 5 percent and most to be significantly different at the 0.5 percent or less significance level.

The regression equations are summarized in Table 7.21. The percent disturbed soil is a common dependent variable in all the regressions. Other combinations of variables, including percent rock cover, percent vegetative cover and percent total cover, were used to develop regression relations. The final relations were based on the previously described tests and maintaining similar variables among the relations for different vegetation type and moisture condition. Even though this was a consideration, Equations 1 and 5 are functions of DISC whereas Equation 9, which should be similar, is not.

7.7 Evaluation of the Adequacy of Sample Size

The sample size for statistical analysis of each variable varied according to the data group being considered. If data was analyzed by run type, there were 24 samples with 15 sample values in each set. If data was analyzed by plot type, there were 12 samples with 30 sample values in each set. Analyzing data by replication number resulted in 15 samples with 24 sample values. A general question related to all the data sets is "How many data values are enough for each data set?"

To determine the number of sample values required for each set of data, certain assumptions are made. First, the statistical test is based on the number of sample values required to estimate the sample mean within a given accuracy at a given confidence level. An estimate of the population standard deviation must also be known. Based on this information, the standard equation used to estimate the confidence interval for the sample mean with known variance is solved for the sample size, with:

$$n = \frac{t^2 \sigma^2}{L^2} \qquad (7.11)$$

where

n = sample size

$t_{\frac{\alpha}{2}}$ = standard normal deviate at given significance level

σ^2 = estimated population variance

L = tolerance range of the sample mean

If L is expressed as a fraction, f, of the mean, μ, Equation 7.12 becomes:

$$n = \frac{t^2 \sigma^2}{(f)^2 \mu^2} \qquad (7.12)$$

If σ is replaced by the sample unbiased standard deviation and μ by the sample mean, the term σ/μ becomes the coefficient of variation as calculated for data groups for all variables measured from the field study. The range of coefficients of variations can be compared to Figure 7.1 and the sample size required to estimate the sample mean within 15 and 20 percent at a 10 percent significance level is shown. The predominant range in coefficients

Table 7.21. Summary of Multiple Regression Relations.

Eq. #	Moisture Condition	Vegetative Cover	Dependent Variable Y	Coefficent a	Independent Variables			Coefficients Corresponding to Independent Variables			Multiple Coefficient of Determination r^2
					x_1	x_2	x_3	b_1	b_2	b_3	
1	Dry	Bare	EC2	102.6	DISC	DISC^2	SLOP	16.4	-0.227	4389.	18.1
2	Wet	Bare	EC2	20.6	DISC	DISC^2	SLOP	13.2	-0.170	6156.	18.5
3	Dry	Bare	INF	-0.92	DISC^2	RFR	-	0.0001	0.254	-	54.5
4	Wet	Bare	INF	-1.34	DISC^2	RFR	-	0.00004	0.283	-	33.8
5	Dry	Mat	EC2	235.6	DISC	DISC^2	SLOP	-6.76	0.181	4031.	39.3
6	Wet	Mat	EC2	184.5	DISC	DISC^2	SLOP	-7.35	0.174	4362.	36.1
7	Dry	Mat	INF	-1.26	DISC^2	RFR	VEGC	0.0001	0.285	0.0190	72.8
8	Wet	Mat	INF	-1.06	DISC^2	RFR	VEGC	0.00003	0.235	0.0113	40.1
9	Dry	Nuttall	EC2	178.4	DISC^2	SLOP	-	0.0581	3641.	-	21.4
10	Wet	Nuttall	EC2	71.5	DISC^2	SLOP	-	0.0502	4561.	-	31.5
11	Dry	Nuttall	INF	-1.12	DISC^2	RFR	VEGC	0.0001	0.289	0.0081	54.4
12	Wet	Nuttall	INF	-1.42	DISC^2	RFR	-	0.00002	0.316	-	56.1

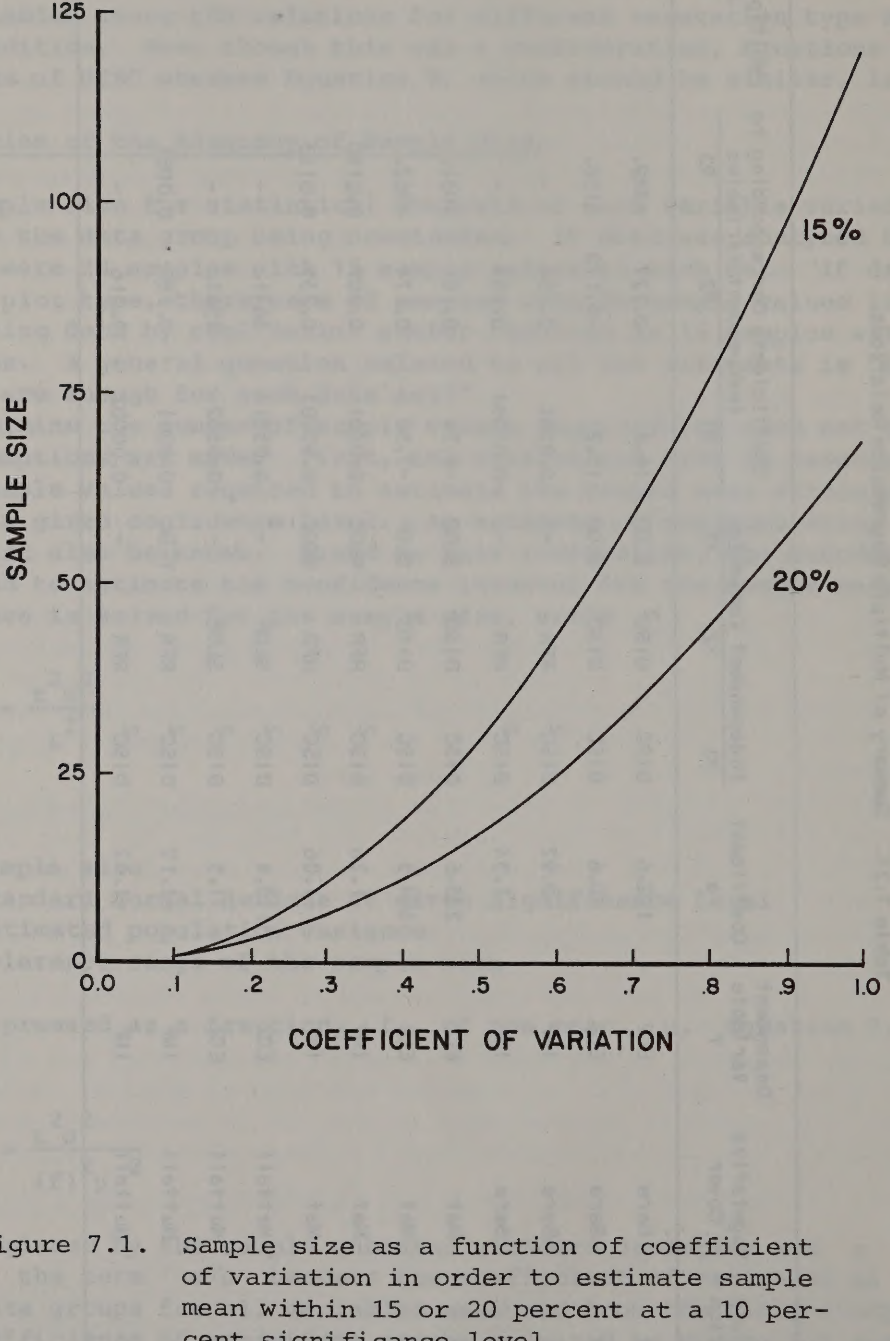


Figure 7.1. Sample size as a function of coefficient of variation in order to estimate sample mean within 15 or 20 percent at a 10 percent significance level.

of variation for the data was from 0.1 to 0.6. The corresponding sample size to estimate the sample mean within 15 percent at a 10 percent significance level ranges from 1 to 43. Larger coefficients of variation from this study were associated with electrical conductivity and chemical constituent measurements. For sample statistics based on run type, there are 24 samples of size 15. Therefore, with an estimated coefficient of variation of 0.5, a sample size of 7 would estimate the sample mean within 20 percent at a 10 percent significance level.

VIII. DISCUSSION OF RESULTS

8.1 General

Based on the statistical analysis detailed in Chapter VII, the specific hypotheses given in Section 1.2 can be now evaluated. Section 8.2 below considers each hypothesis individually and either supports or refutes the hypothesis based on the available data. Additionally, based on the field data, the statistical analyses and the hypothesis testing general trends can be identified and implications made concerning grazing management (Section 8.3).

8.2 Hypothesis Testing

8.2.1 Hypothesis: The Effects of Trampling are Measurable.

The first hypothesis stated that the effects of livestock disturbance on infiltration rates, runoff and sediment and salt products are measurable. To evaluate this, a discussion of the accuracy of each measurement compared to the range of measured data is required.

Runoff and salt production (as measured by electrical conductivity) were measured in the field. The accuracy of the measured runoff rates is related to the field procedure. The volumetric method of runoff evaluation involved collecting runoff in a cup from the collector trough and measuring the time with a stop watch. The runoff was then transferred to a 100 ml graduated cylinder. The measured volume of runoff divided by the elapsed time resulted in the runoff rate. It is estimated that the volume could be defined within ∓2 ml and the elapsed time within ∓0.2 seconds. For the range of runoff rates obtained in the field, a measured accuracy of ∓0.3 ml/sec is estimated. Electrical conductivity (EC) was measured in the field with a conductivity meter. The accuracy of the meter reading is ∓5 μmhos/cm. The range of measured EC was 100 to 1,800. The average EC was 450. The error is about 2 percent of the average EC. Table 8.1 summarizes the range of measured values, the average of the measurements, the accuracy of the measurements and the error as a percent of the average of the measurements. From this table, most errors of measurement are within about 10 percent and many are within a smaller range which is an acceptable level of accuracy for experimental work. Three measurements with a larger percentage possible error are percent rock cover by point and cell method and plant height. However, these variables are not considered critical and the errors are acceptable. Also, the magnitude of the measurements is small and even small errors generate large possible percentage errors.

8.2.2 Hypothesis: The Effects of Trampling on Runoff and Salt and Sediment Production Far Outweigh the Role of Plant Cover Normally Encountered on Mancos Sites, and Characterizing Selected Study Sites.

This hypothesis was found to be false in some cases due to the manner in which study sites were selected. Plot types were selected as bare or vegetated with a percent vegetated cover ranging from 4 to 34 percent. Compared to the 5 to 10 percent vegetative cover normally encountered on Mancos sites

Table 8.1. Estimated Accuracy of Measurements.

Variable	Range of Measurements	Average of Measurements	Error of Measurement	Error as a % of Average of Measurements
EC1	69 - 1800	451	±5	2
EC2	50.9 - 1369	370	±5	3
pH (Field)	7.5 - 9.3	8.4	±.5	12
QP	7.0 - 12.7	9.0	±.3	7
VRO	6628 - 18562	13382	±540	12
RFR	5.04 - 7.9	6.53	*	12
IFR	0.06 - 1.77	0.80	*	12
VEGP	0.0 - 34.0	9.5	±.5	11
TLITP	0.0 - 44.0	8.9	±.5	11
ROCKP	0.0 - 17.0	2.7	±.5	37
TCOVP	1.0 - 66.0	21.2	±.5	5
TBARP	34.0 - 99.0	78.8	±.5	1
DISP	0.0 - 81.0	24.7	±.5	4
VEGC	0.0 - 38.8	10.4	±.5	10
TLITC	0.5 - 39.0	9.6	±.5	10
ROCKC	0.8 - 16.3	4.0	±.5	25
TCOVC	3.6 - 64.8	24.0	±.5	4
TBARC	35.2 - 96.4	76.0	±.5	1
DISC	0.0 - 81.8	25.9	±.5	4
DIA	0.0 - 31.0	10.0	±.5	10
HEI	0.0 - 10.0	3.5	±.5	29
EC (Chem)	60 - 1480	446.4	±5	2
pH (Chem)	5.3 - 9.1	7.9	±.5	13
TA	9.6 - 30.6	17.0	±1	12
TDS	.031 - 2.913	0.355	±.001	1
F^-	0 - 1	0.1	±.1	100
Cl^-	0.25 - 60.0	3.1	±.1	7
$SO^=_4$	0 - 1555	179.8	±.1	1
Na	0 - 30.4	5.5	±.1	4
K	0.4 - 12	3.8	±.1	5
Ca	0 - 171.9	44.4	±.1	1
Mg	0.67 - 5.3	2.3	±.1	9

*Based on volume estimate of accuracy

this selection technique for the small test plots biased the results for evaluation of this hypothesis. However, there was little choice available in selecting the vegetated plots, due to the sparse vegetation. When possible, smaller plants were used; however, as evidenced by the range of vegetative cover, some large plants had to be used. It was not considered feasible to place the edge of the plot frame through a plant due to the disturbance it would create to the plant and soil.

The bias is visible when considering the ANOVA results, Table 7.16. There is significant variation in the mean due to the vegetation factor for peak runoff, volume of runoff and infiltration rate.

8.2.3 Hypothesis: The Effects of Livestock Disturbance on Runoff, and Salinity and Sediment Production Increase with Increased Percent Trampling Disturbances

To evaluate the effects of increased livestock disturbance on runoff and salinity and sediment production, the results of the two sample t-tests are considered. Table 7.7 showed the results of the two sample t-tests for the variables of interest. The sample means of electrical conductivity measurements for trampling levels 1 and 4 are not from the same population. Also, the sample means for volume of runoff and sediment concentration at trampling levels 1 and 4 are from different populations. So, increased trampling is directly associated with increased salt and sediment production and inversely associated with runoff volume. Also, normalized peak runoff is not significantly affected by trampling level as is shown in Table 7.7, for a significance level of 1.

8.2.4 Hypothesis: The Effects of Livestock Disturbance are Dependent Upon the Interaction of Soil Texture with Antecedent Soil Moisture Condition

Based on the results of the ANOVA, antecedent moisture condition does cause significant variation in the means of runoff peak, volume of runoff, infiltration rate and sediment concentration. The variation in the means of electrical conductivity due to antecedent moisture condition is significant at a level of 0.04 to 0.007.

The effect of antecedent moisture condition also shows up in the mean calculation where the mean trends of dry runs parallel mean trends of wet runs. For example, the mean of electrical conductivity and infiltration rate by plot type for dry runs is always slightly greater for the same plot type with wet runs. The mean of runoff volume by plot type for dry runs is always less than the mean of runoff volume by plot type for wet runs.

8.2.5 Hypothesis: Trampling Induces Predictable Physical Changes in the Soil Water Infiltration Properties of Mancos Shale-Derived Soil

The effects of trampling on the mean for infiltration rates is statistically significant as shown from the results of the ANOVA (Table 7.16). An increase in trampling level increases the infiltration rate enough that the sample means for trampling level 1 and 4 are assumed to be from different populations (Table 7.7). Trampling level 4 corresponds to an average percent plot disturbance of approximately 60 percent.

Increased infiltration with increased trampling can be physically explained in two ways. First, trampling breaks up the typically hard, dry vesicular soil crust and consequently allows greater infiltration. Second, the presence of hoof prints creates increased ponding and a correspondingly higher infiltration rate due to standing water.

8.2.6 Hypothesis: Plot Runoff and Soil Loss Are Related

Plot runoff and soil loss were related for bare plots and plots with Nuttal bushes at the five percent level for wet runs. A correlation of plot runoff volume and sediment concentration by vegetative cover gave correlation coefficients ranging from 0.12 to 0.35, for the wet antecedent moisture condition. The soil loss from dry run plots may be more sensitive to the availability of loose soil. For this condition the correlation coefficients ranged from -0.17 to 0.07.

8.2.7 Hypothesis: Percent Bare Soil is a Good Predictor of Simulated Storm Runoff Peak Discharge and Volume.

Based on correlation coefficients this hypothesis was not totally true. Correlation coefficients between percent bare soil and runoff volume ranged from positive to negative. Runoff volume was inversely related to percent disturbed. Correlation coefficients by vegetation type between percent disturbed and runoff volume ranged from -0.58 to -0.64 for dry runs and -0.24 to -0.38 for wet runs (Tables 7.18 to 7.20). Peak runoff was fairly constant and was not correlated with other variables.

8.2.8 Hypothesis: Total Salt Production is Independent of the Amount of Soil Lost from a Mancos Site Plot Via Sheet and Rill Erosion.

For wet runs on all plots this hypothesis is not true and is also not true for dry runs on plots vegetated with mat saltbush only (based on the one or five percent significance level). The correlation coefficient between sediment concentration (soil loss) and electrical conductivity (salt production) ranged from 0.22 to 0.45 for dry runs and 0.30 to 0.44 for wet runs.

8.3 Implications of Study Results on Grazing Management Policies

Based on the detailed statistical analysis and hypothesis testing general implications regarding grazing management policy can be made. It is important to realize that these statements are made based on the results of this study using small plot rainfall simulation devices on one unique study site. Therefore, an understanding of the limitations imposed by the experimental design is essential and will be considered as required throughout the following discussion. To facilitate the discussion a qualitative, graphical summary of the study results will first be given.

The general results of the statistical analysis and hypothesis testing can be summarized by qualitative graphs that illustrate the relationships between trampling intensity and other study variables. The qualitative graphs for the most significant results of the study are given in Figure 8.1. Figure 8.2 summarizes other important results. It must be emphasized that these graphs are qualitative and can only be used to illustrate general trends observed in the measured data or deduced from the data analysis. No implications are made or suggested regarding quantitative values such as magnitudes or rates of change.

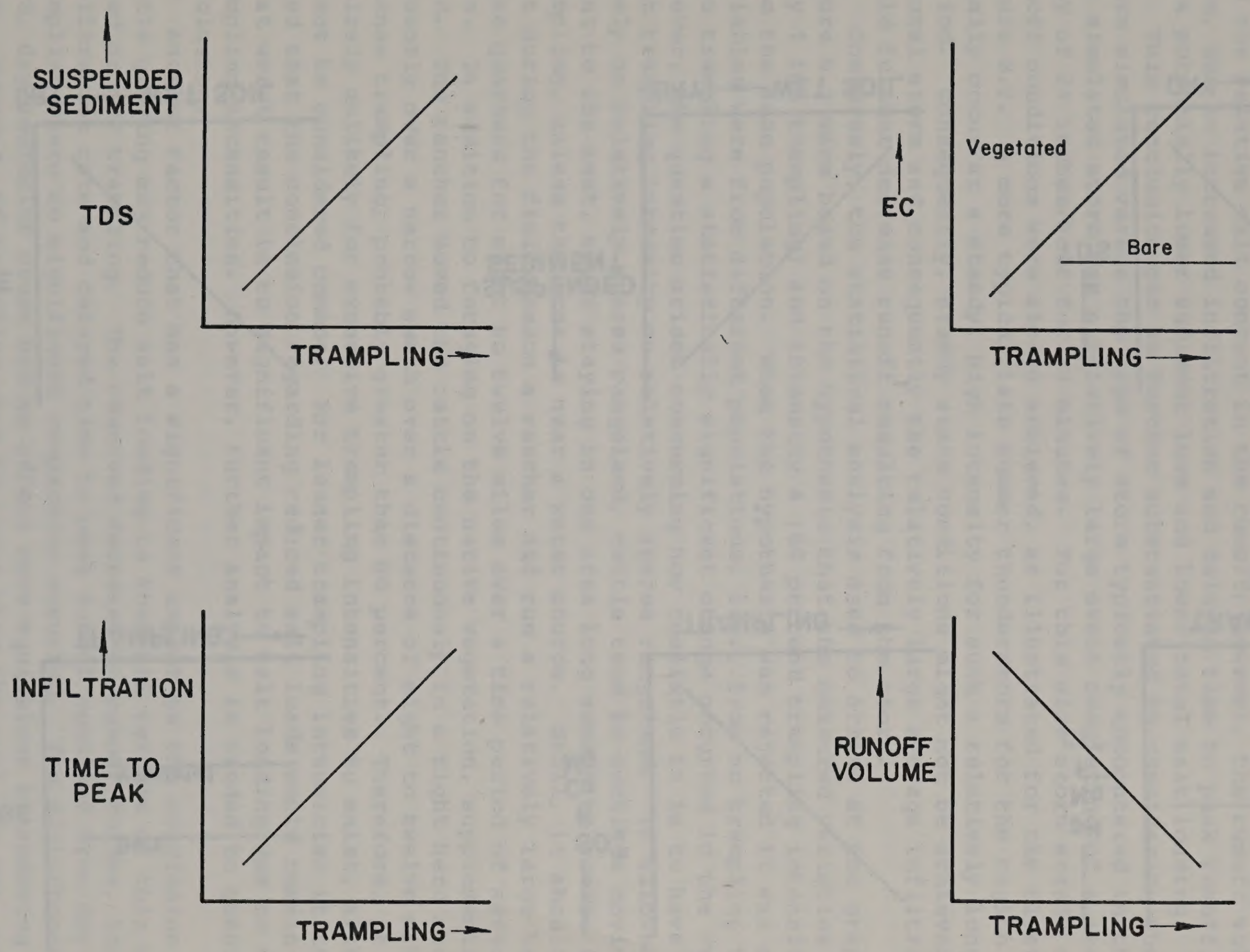


Figure 8.1. Qualitative relationships for significant study variables.

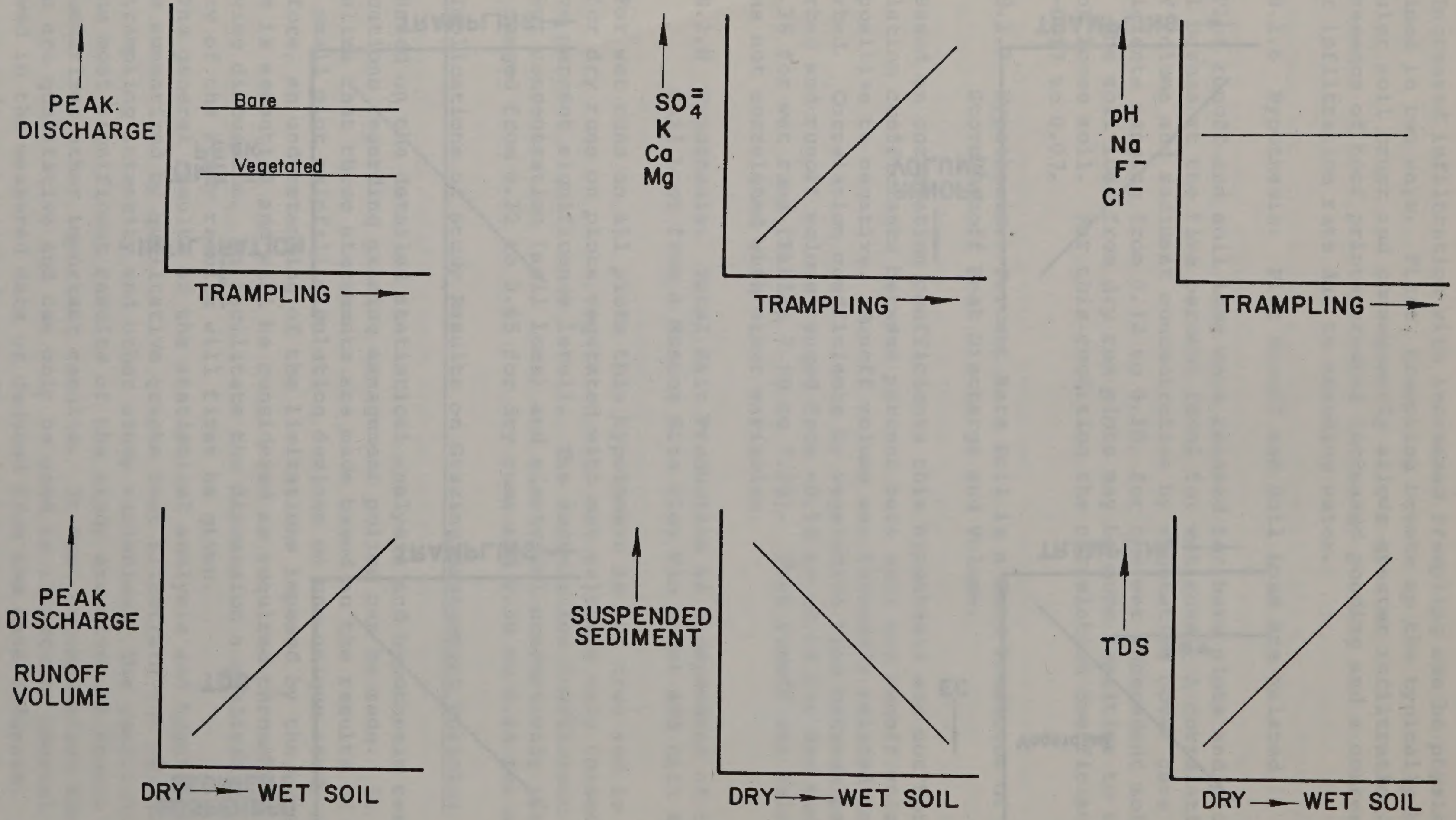


Figure 8.2. Qualitative relationships for other important variables.

The top two graphs on Figure 8.1 illustrate the increased erosion and salt content of the surface runoff that occurs with increased trampling. The bottom two graphs of the same figure illustrate the observed decrease in runoff volumes with increased trampling, and the corresponding increased infiltration rate and time to peak. Based on these four graphs the conclusion could be reached that trampling increases suspended sediment concentrations and the relative salt content in the runoff; however, the runoff volume is less, due to increased infiltration and delayed time to peak runoff, resulting in a potentially lower sediment loss and lower total salt loading.

This conclusion can be further substantiated by considering the type of storm simulated versus the type of storm typically encountered in the region. The simulated storm was a relatively large event consisting of a steady intensity of 2+ inches/hour for 30 minutes. For this size storm steady state runoff conditions were always achieved, as illustrated for the first graph of Figure 8.2. A more typical late summer thunderstorm for the region would not usually occur at a steady, high intensity for such a relatively long time period. Consequently, steady state conditions might not be achieved during a natural storm and consequently the relatively large average infiltration rate would further decrease runoff resulting from the storm.

Conversely, the statistical analysis used to arrive at the graphs of Figure 8.1 were based on the hypothesis that the measured variables for intensity 1 (no trampling) and intensity 4 (60 percent trampling intensity) are from the same population. When the hypothesis was rejected it was assumed the variables were from different populations, i.e., from no trampling to excessive trampling a statistically significant change occurred in the variable. However, the question arises concerning how realistic it is to have a 60 percent trampling intensity on relatively sparse rangeland. If allowed to roam freely on relatively sparse rangeland, cattle tend to continue moving from one plant to the next, never staying in one area long enough to create intense trampling, unless the area is near a water source. Still, it should be noted that during the field season a rancher did run a relatively large herd in close quarters for eight to twelve miles over a time period of seven to ten days. In addition to foraging on the native vegetation, supplemental hay was used. The rancher moved the cattle continuously in a tight herd and consequently over a narrow swath over a distance of eight to twelve miles created intense trampling, probably greater than 60 percent. Therefore, it is not entirely unlikely for excessive trampling intensities to exist, although they cannot be considered common. For lesser trampling intensities it is anticipated that the conclusion regarding reduced salt loads would remain the same or at worst result in no significant impact to salt loading due to the lower trampling intensities. However, further analysis is needed to quantify this conclusion.

Another factor that has a significant impact on the conclusion that cattle grazing may reduce salt loading is that all results of this study are based on dry trampling. The observed decrease in runoff volume, increase in infiltration rate and delayed time to peak runoff resulted from dry soil trampling where no significant compaction occurred. The disturbance to the hard, dry vesicular crust had an effect more equivalent to reducing compaction. However, if trampling were to occur when the soil was wet, resulting in greater compaction, the conclusions might be substantially different. Therefore, the recommendation based on the implications of the study results would be to minimize grazing activities during the snowmelt period of spring and the late summer thunderstorm period.

Finally, the bias in the experimental design due to greater vegetation densities than typically encountered may modify the conclusion regarding the beneficial impact of grazing on salt loads. The greater cover on vegetated plots creates more interception per unit area in the study plot than over the natural rangeland (see Section 8.2.2). The tradeoff between increased salt production and decreased runoff volume may not be as favorable for natural rangeland with plant densities of five to ten percent.

The important relations between dry and wet antecedent moisture conditions were given in the bottom three graphs of Figure 8.2. The results suggest that when several thunderstorms occur during a short period, the salt loading might increase due to greater runoff volume. It is interesting to note that the TDS is relatively constant from dry to wet antecedent soil moisture conditions. Based on field obsevations after one runoff event has occurred, and the soil dried, the observed disturbance created by dry trampling is significantly decreased. Typically, the hoof print depression would still be visible, however, all loose soil would be gone and the vesicular crust re-formed.

The final consideration in applying the study results to grazing management decisions is the limitation of small-plot rainfall simulation research conducted on one unique study site. The study results can be used for evaluating relative changes and establishing general trends; however, extraction of quantitative numbers and use of regression relationships for quantitative prediction should not be done, even for areas that are similar in soil, topography and climate. As stated in Section 4.1, the drop forming rainfall simulator produces less raindrop energy than a natural rainstorm and also produces a uniform drop size. Therefore, soil loss quantities are less for the simulation than they would be for an equivalent intensity natural storm. Further, since the results were derived for a unique study site with a single soil type and uniform topography consisting of low slope, use of the regression equations for prediction on other soil types or topography would not be feasible.

The use of small plot rainfall simulators did produce a large amount of useful information, particularly related to water quality, that would have been difficult to obtain with any other simulator. Additionally, the ease in operation of this simulator allowed efficient data collection for the replications of the experimental design.

IX. SUMMARY AND CONCLUSION

9.1 Summary

The purpose of this study was to collect field data in order to quantify and analyze the effects of trampling by livestock (during simulated grazing) on infiltration rates, runoff, sediment production and salt content of surface runoff from Mancos Shale-derived soils. Small-plot rainfall simulators were used to simulate summer thunderstorms. The preceding chapters describe the comprehensive field study and data collection and the ensuing data organization and preliminary statistical analysis. The analysis of the data was limited to calculating basic statistics (mean, standard deviations, and coefficients of skewness and variation) and testing hypotheses specified by BLM management. The hypothesis testing involved two sample t-Tests to determine if the sample means are from the same population, analysis of variance (ANOVA) to determine the effect of trampling, vegetative cover or moisture condition on means of measured variables, correlation between variables and regression relations to describe electrical conductivity and infiltration rates as functions of resource characterization and field data variables.

Analysis of the data indicated that salt content measured as total dissolved solids or electrical conductivity increased with increased trampling; however, total runoff volumes decreased due to increased infiltration rates. Therefore, grazing may have a beneficial effect on total salt load delivered from diffuse surface runoff sources. The generality of this conclusion is limited by the experimental design. The research of this study involved small-plot rainfall simulation on only one unique study site. Additionally, trampling treatments were conducted only on dry soil which resulted in no significant compaction. Trampling by cattle or sheep on wet soil may decrease infiltration and increase runoff due to the effects of compaction.

9.2 Conclusion

Although the study results suggest cattle or sheep grazing, or the trampling effect by animals during grazing, may decrease the salt load from diffuse surface runoff sources, other factors must be considered in formulating grazing management policies. Overgrazing that results in excessive damage to the plants by trampling or elimination of decreaser plants (those most valuable as forage plants) will ultimately increase sediment and salt loading to downstream channels. Therefore, the critical factors in formulating grazing management policies may be those that help to maintain an adequate range condition, where range condition is defined as the status of the existing plant community under grazing to the potential status of the natural plant community without grazing for that site.

Additional research is recommended to further quantify the results of this study. Consideration should be given to other soil types and topographic conditions. A thorough understanding of all possible conditions is necessary to develop adequate grazing management systems. The implementation of sound grazing management policies, combined with range improvement projects, will increase the productivity and use of rangeland.

X. REFERENCES

Albertson, F.W., Tomanek, G.W. and Riegal, A., 1957. "Ecology of Drought Cycles and Grazing Intensity on Grasslands of Central Great Plains," Ecological Monographs 27(1):27-44.

American Public Health Association, et al., 1981. Standard Methods for the Examination of Water and Wastewater, R. R. Donnelley and Sons Co., 15th edition.

Brown, E., Skougstad, M.W., Fishman, M.J., 1974. "Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases," Techniques of Water Resources Investigations of the U.S. Geological Survey, Book 5, Chapter A1.

Bureau of Land Management, USDI, 1978. "1977 Status Report on the Effects of Surface Disturbance on the Salinity of Public Lands in the Upper Colorado River Basin," Report No. BLM/YA/TR-78/01, February.

Cannon, H. L., 1960. Development of Botanical Methods of Prospecting for Uranium on the Colorado Plateau. U.S. Geological Survey Bulletin No. 1085-A. 56 pp.

Dasmann, R. F., 1972. Environmental Conservation, John Wiley and Sons, Inc., Third Edition.

Environmental Protection Agency, 1971. The Mineral Quality Problem in the Colorado River Basin - Summary Report. Regions VIII, IX. 65 pp.

Evangelou, V. P., L. D. Whittig, and K. K. Tanji, 1981a. "Dissolved Mineral Salts Derived from Mancos Shale I. Cation Ion Exchange." Submitted for possible publication to the Soil Science Society of America Journal, July.

Evangelou, V. P., L. D. Whittig and K. K. Tanji, 1981b. "Dissolved Mineral Salts Derived from Mancos Shale II. Dissolution and Desorption of Ca and Mg." Submitted for possible publication to the Soil Science Society of America Journal, July.

Guy, H. P., 1977. "Laboratory Theory and Methods for Sediment Analysis." Techniques of the Water Resources Investigations of the U.S. Geological Survey, Book 5, Chapter C1, Third Edition.

Hackman, F. C., C. Bigler and W. C. Kirk, 1968. Utah Coal-Market Potential and Economic Impacts. Bureau of Economic and Business Res. College of Business and the Center for Economic Community Development. University of Utah, Salt Lake City, Utah.

Hillel, D., 1980. Applications of Soil Physics. Academic Press, New York.

Kleinbaum, D.G. and Kupper, L.L., 1978. Applied Regression Analysis and Other Multivariable Methods, Duxbury Press.

Laronne, J. B., 1977. Dissôlution Potential of Surficial Mancos Shale and Alluvium. Ph.D. dissertation, Colorado State University, Fort Collins. 128 pp.

Mundorff, J. C., 1972. "Reconnaissance of Chemical Quality of Surface Water and Fluvial Sediment in the Price River Basin, Utah." Technical Publication No. 39, State of utah, Department of Natural Resources.

Neter, J. and Wasserman, W., 1976. Applied Linear Statistical Models, Richard D. Irwin, Inc.

Ponce, S. L. II, 1975. Examination of a Nonpoint Source Loading Function for the Mancos Shale Wildlands of the Price River Basin, Utah. Ph.D. disseration, Utah State University, Logan. 177 pp.

Ryan, T.A., Joiner, B.L., Ryan, B.F., 1976. MINITAB, Student Handbook, Duxbury Press.

Shantz, N. L., and R. Zon, 1964. Natural Vegetation. USDA Atlas of American Agriculture. 22 pp.

Shen, H. W., 1981. Rate of Sediment in Salt Loading from Hillslopes. Prepared for OWRT, Washington, D.C.

Simons, Li & Associates, Inc., 1981. "Plot Photographs for BLM Study, Contract No. YA-553-CTO-199,"

Snedecor, G.W. and Cochran, W.G., 1973. Statistical Methods, The Iowa State University Press.

Sunday, G.K., 1979. "Role of Rill Development in Salt Loading from Hillslopes," M.S. Thesis, Department of Civil Engineering, Colorado State University.

Swenson, J., D. T. Erickson, K. M. Donaldson and J. J. Shiozaki, 1970. Soil Survey of Carbon-Emergy Area, Utah. USDA Soil Conservation Service, Washington, D.C. 78 pp.

Tanji, K. K., L. D. Whittig and J. W. Biggar, 1977. Role of Sediment in Salt Loading on the Colorado River. Annual Report Project No. B-137-Colo (UCAL-W-509) Water Resources Center, University of California, Davis, California.

Thorne, J. P., L. Wilson, T. B. Hutchings and J. Swenson, 1967. Chemical and physical properties of soils in the Carbon-Emery Area, Utah. Utah Agricultural Experiment Station, URS No. 39, Utah State University, Logan, Utah. 37 pp.

United States Bureau of Reclamation, 1975. Salinity and Sediment Study, Upper Colorado River Basin, Utah, Colorado, Wyoming. June.

White, R. B., 1977. Salt Production from Microchannels in the Price River Basin, Utah. M.S. thesis, Utah State University, Logan. 121 pp.

Whittig, L. D., K. K. Tanji and J. W. Biggar, 1979. Salinity investigations in the West Sale Creek Watershed, Colorado. Annual Report Project No. WRC-UCAL-W-562. Water Resources Center, University of California, Davis, California.

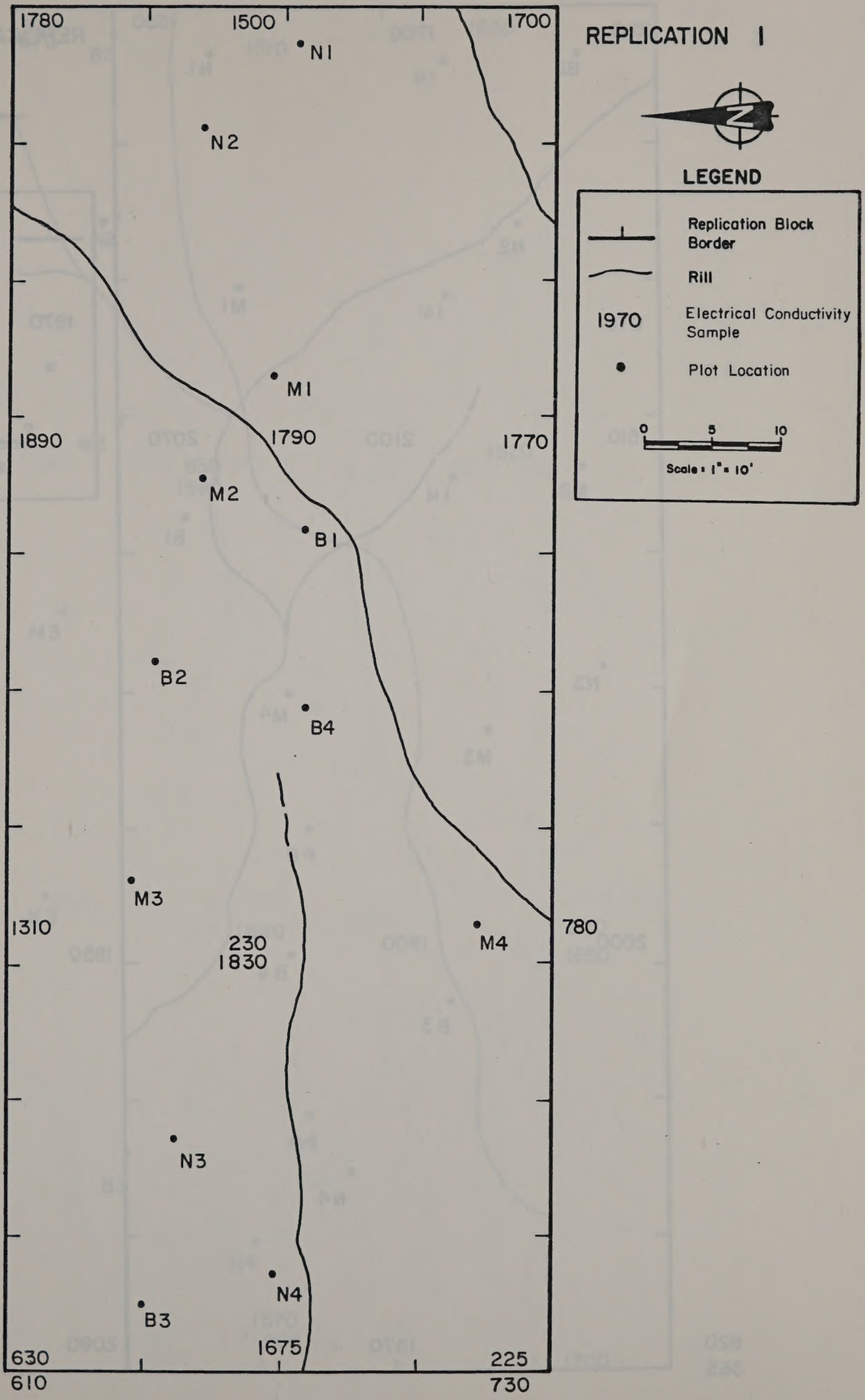
Williams, J. S., 1975. The Natural Salinity in the Colorado River. Utah Water Research Laboratory, Utah State University, Logan, Utah.

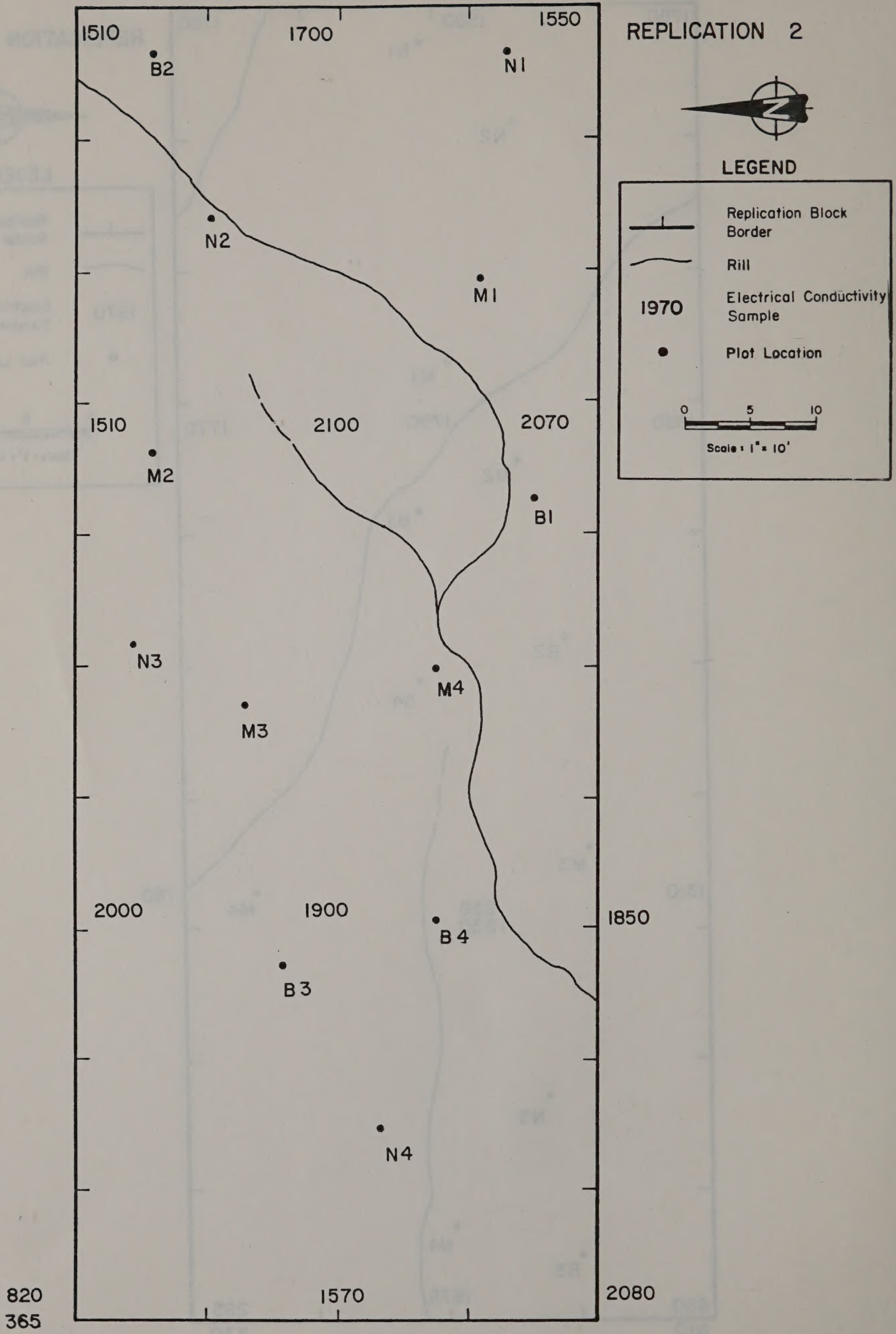
APPENDICES

APPENDIX A

REPLICATION BLOCK DIAGRAMS

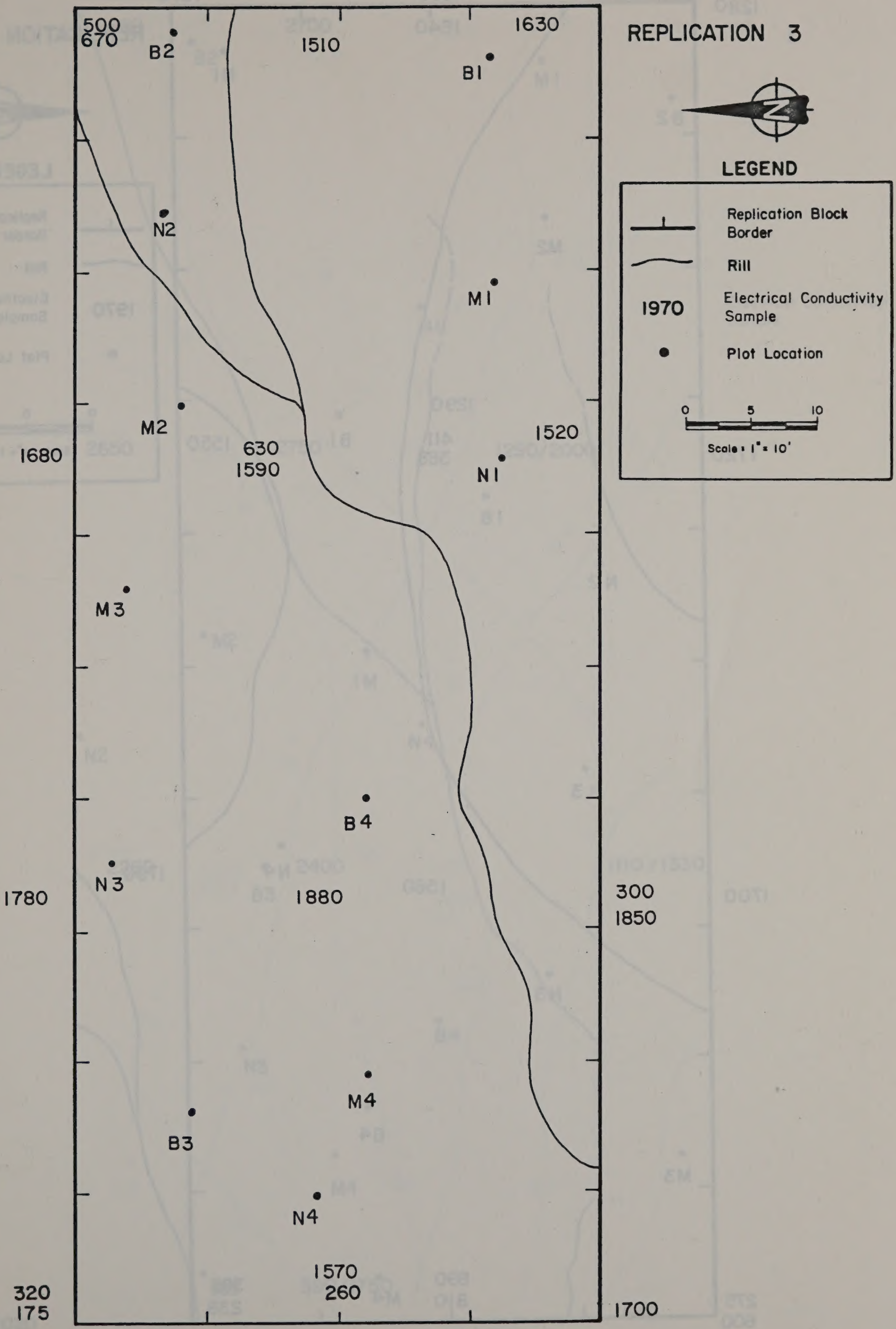
REPLICATION I

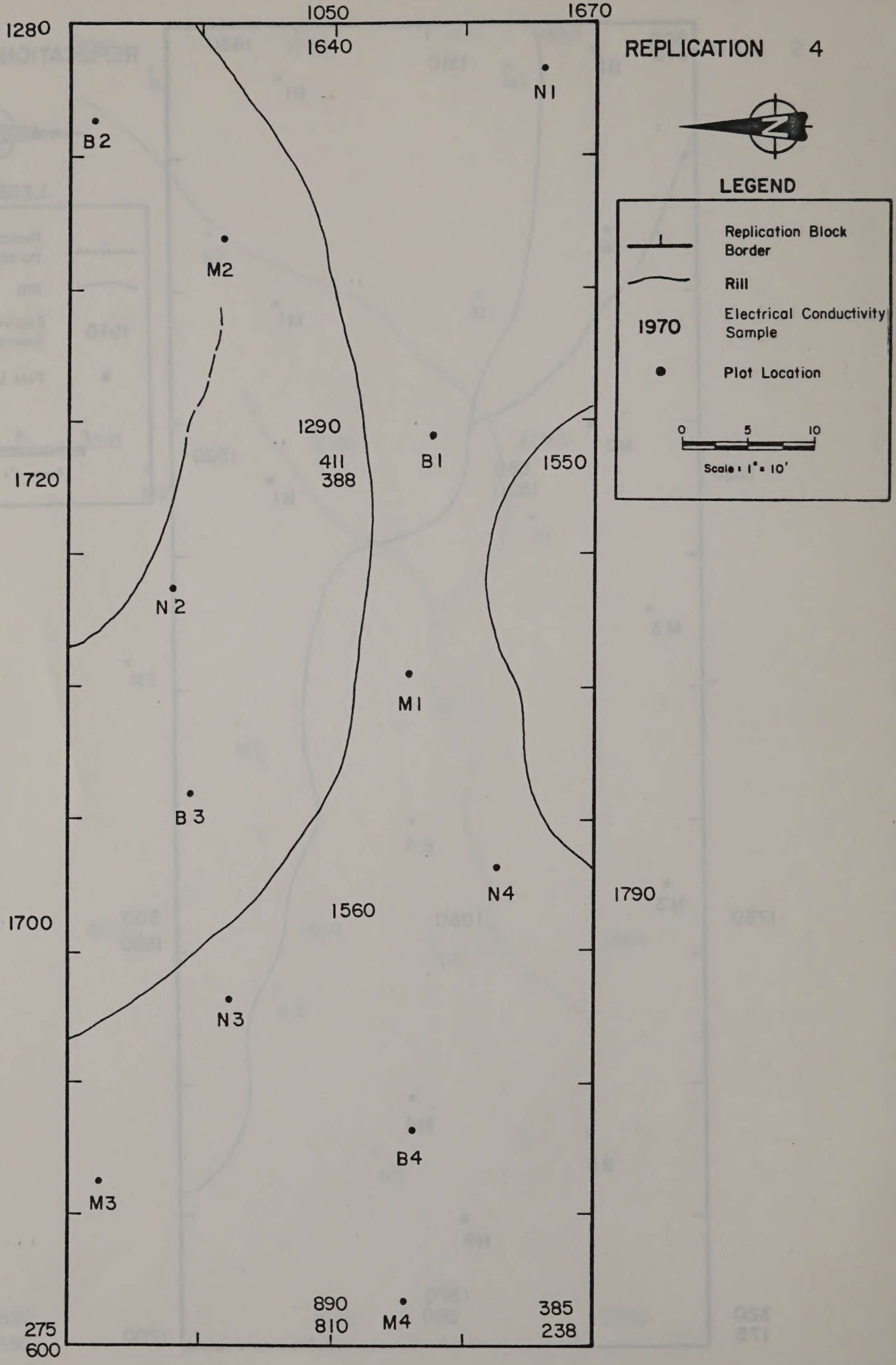




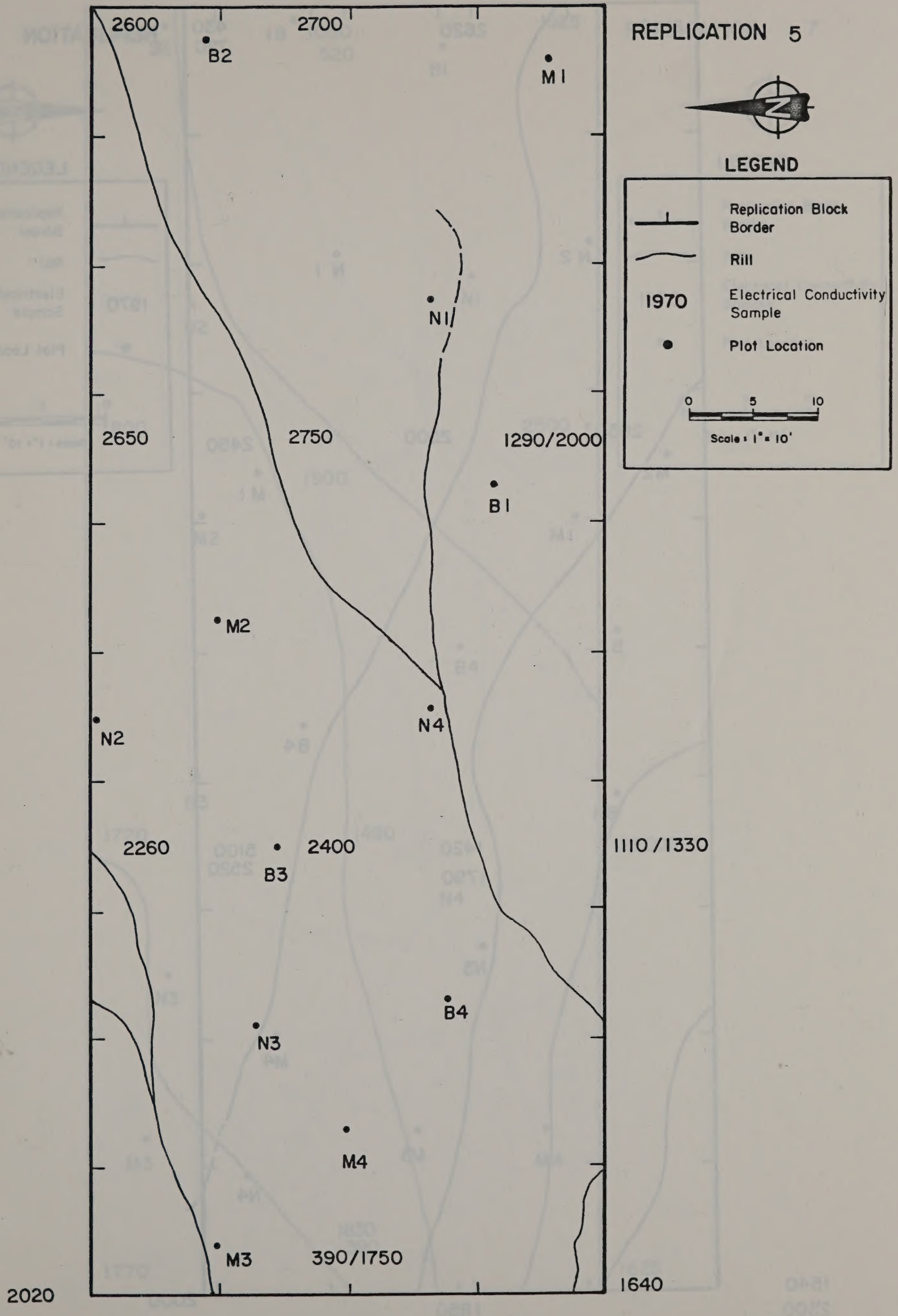
REPLICATION 2

REPLICATION 3

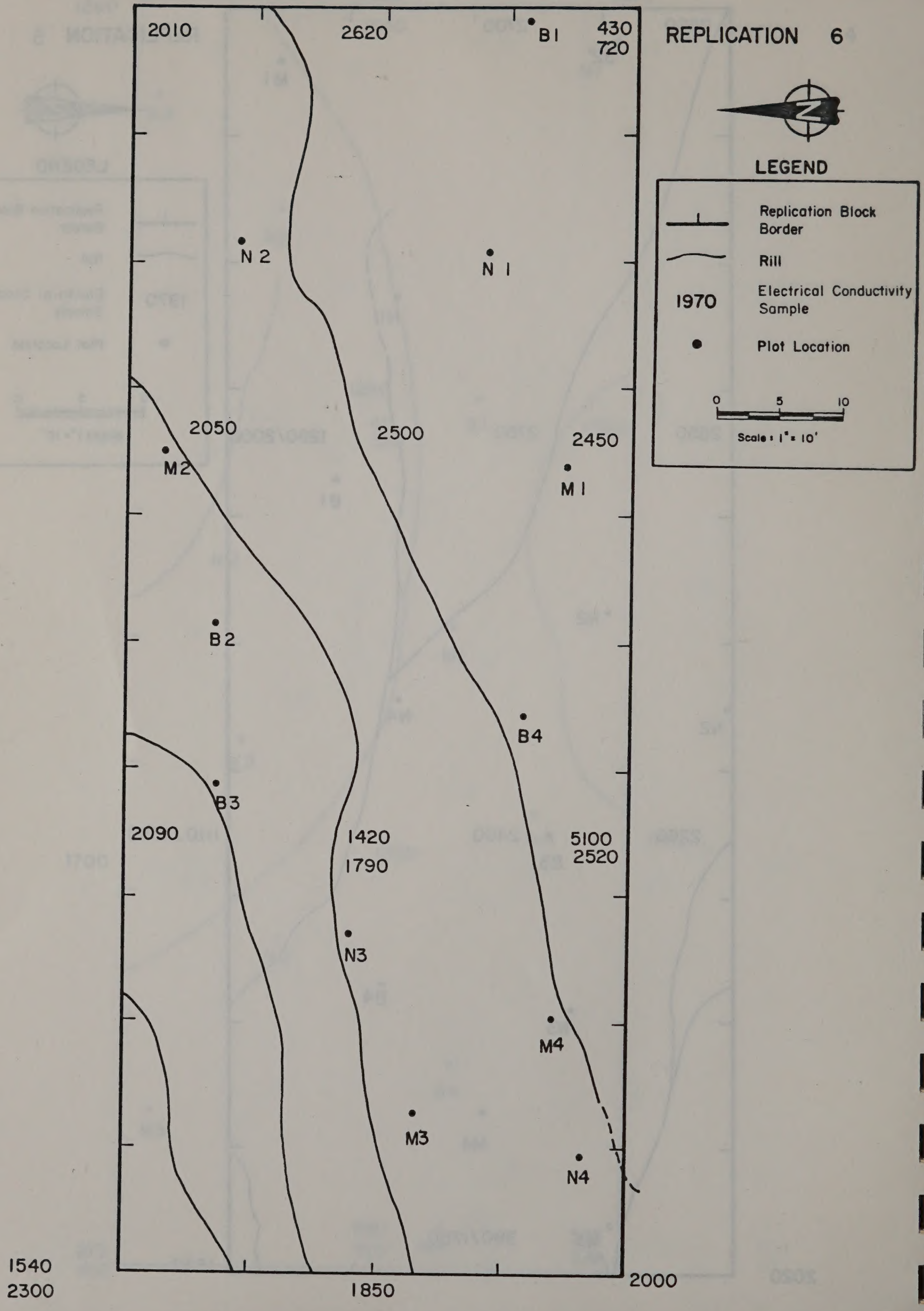


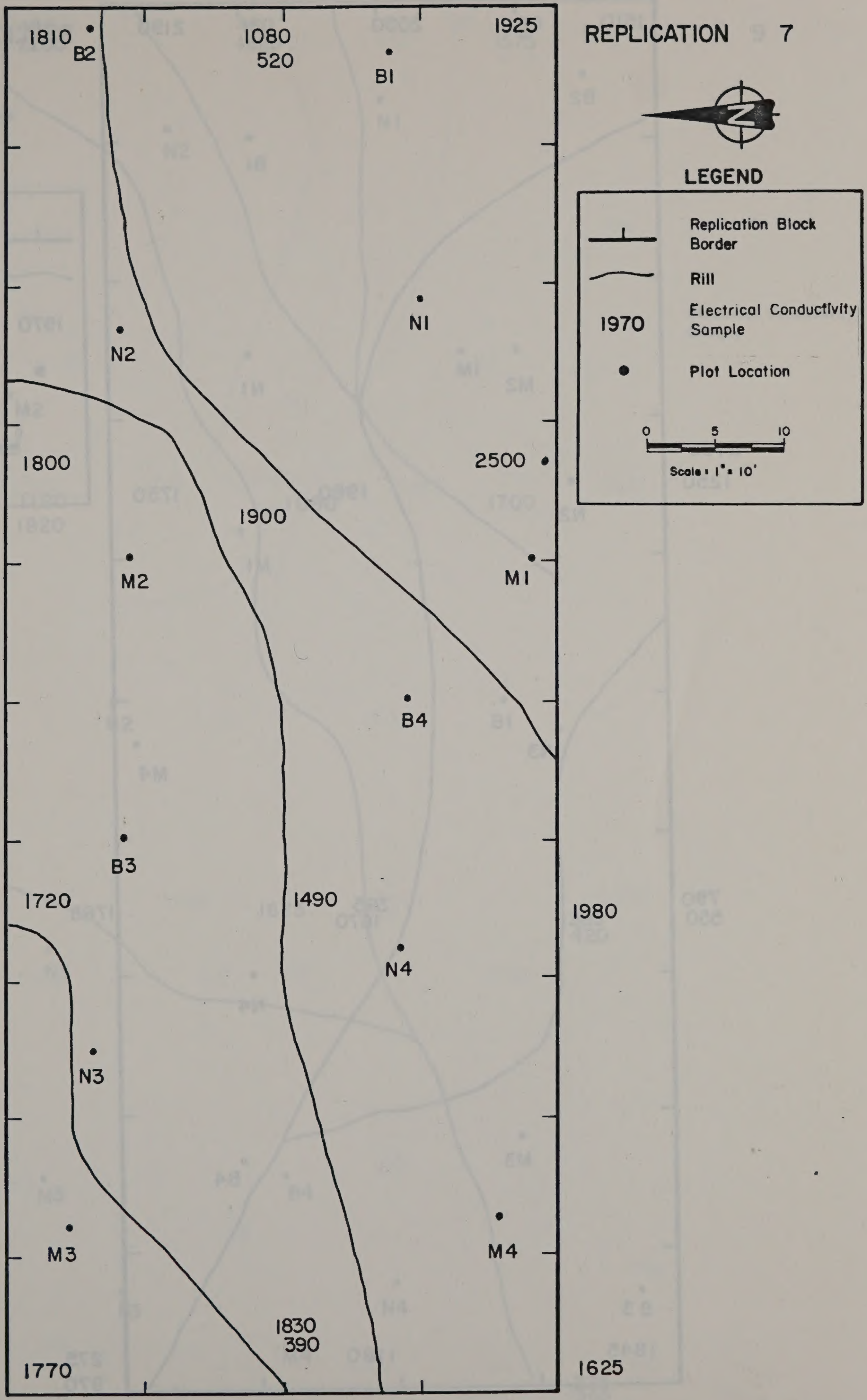

REPLICATION 4
N
LEGEND
Replication Block Border
Rill
1970 Electrical Conductivity Sample
● Plot Location
0
5
10
Scale : 1" = 10'
1280
1050
1670
1640
N1
B2
M2
1290
411
388
B1
1550
1720
N2
M1
B3
N4
1790
1560
1700
N3
B4
M3
890
810
M4
385
238
275
600

REPLICATION 5

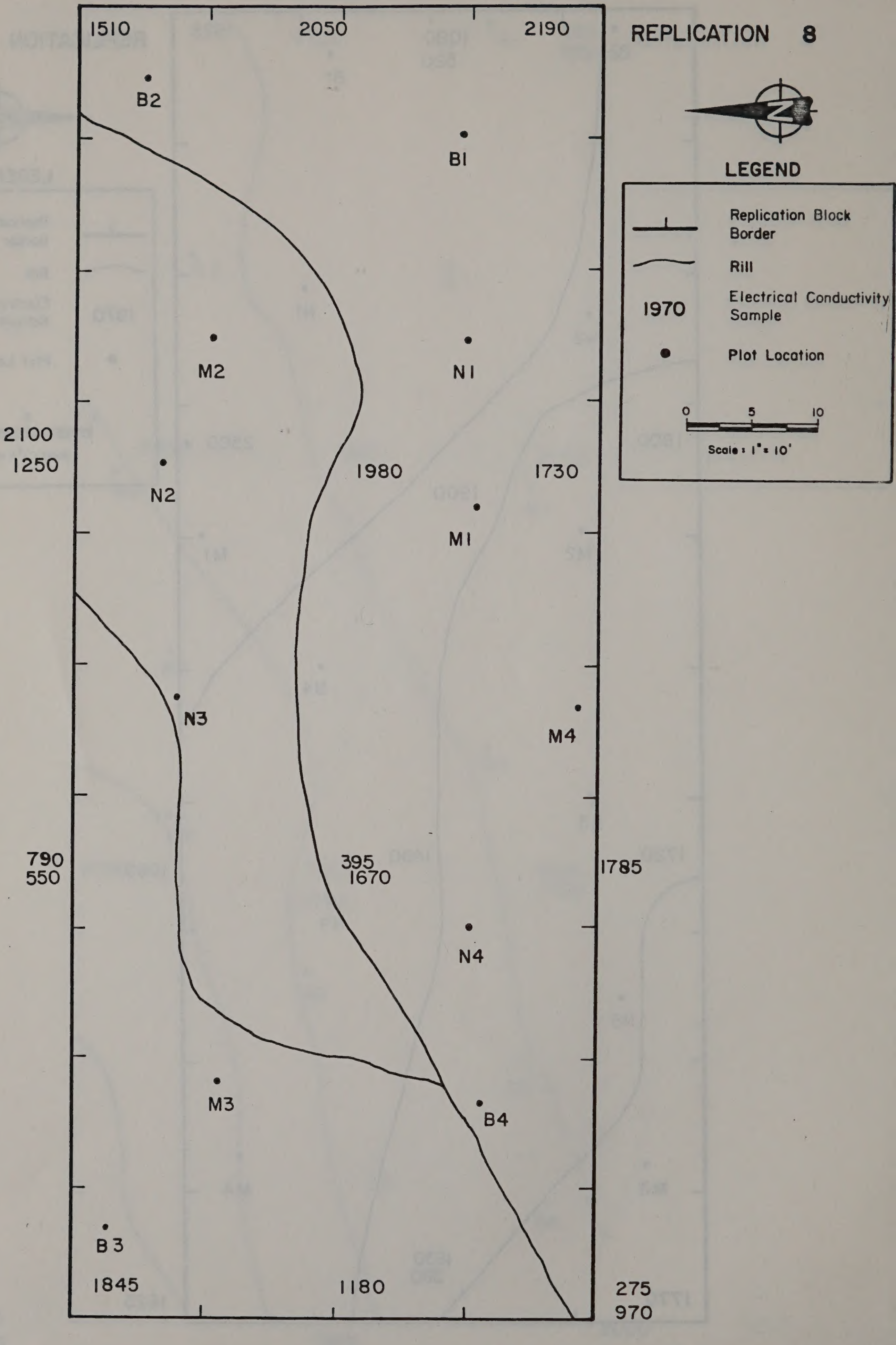


REPLICATION 6

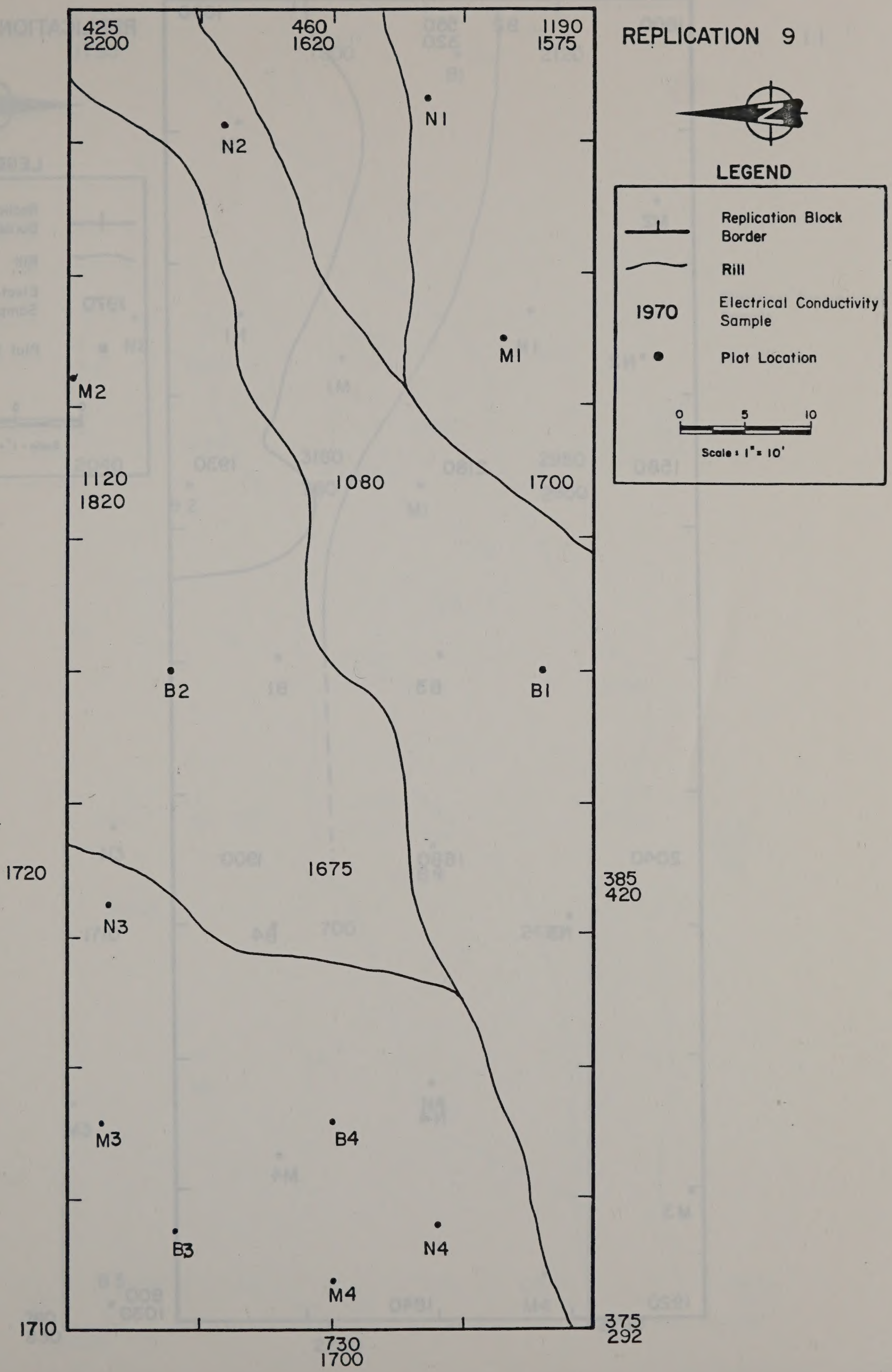



REPLICATION 7
N
LEGEND
Replication Block Border
Rill
1970 Electrical Conductivity Sample
● Plot Location
0 5 10
Scale: 1" = 10'
1810
B2
1080
520
1925
B1
N1
N2
1800
2500
1900
M2
M1
B4
B3
1720
1490
1980
N4
N3
M3
M4
1830
390
1770
1625

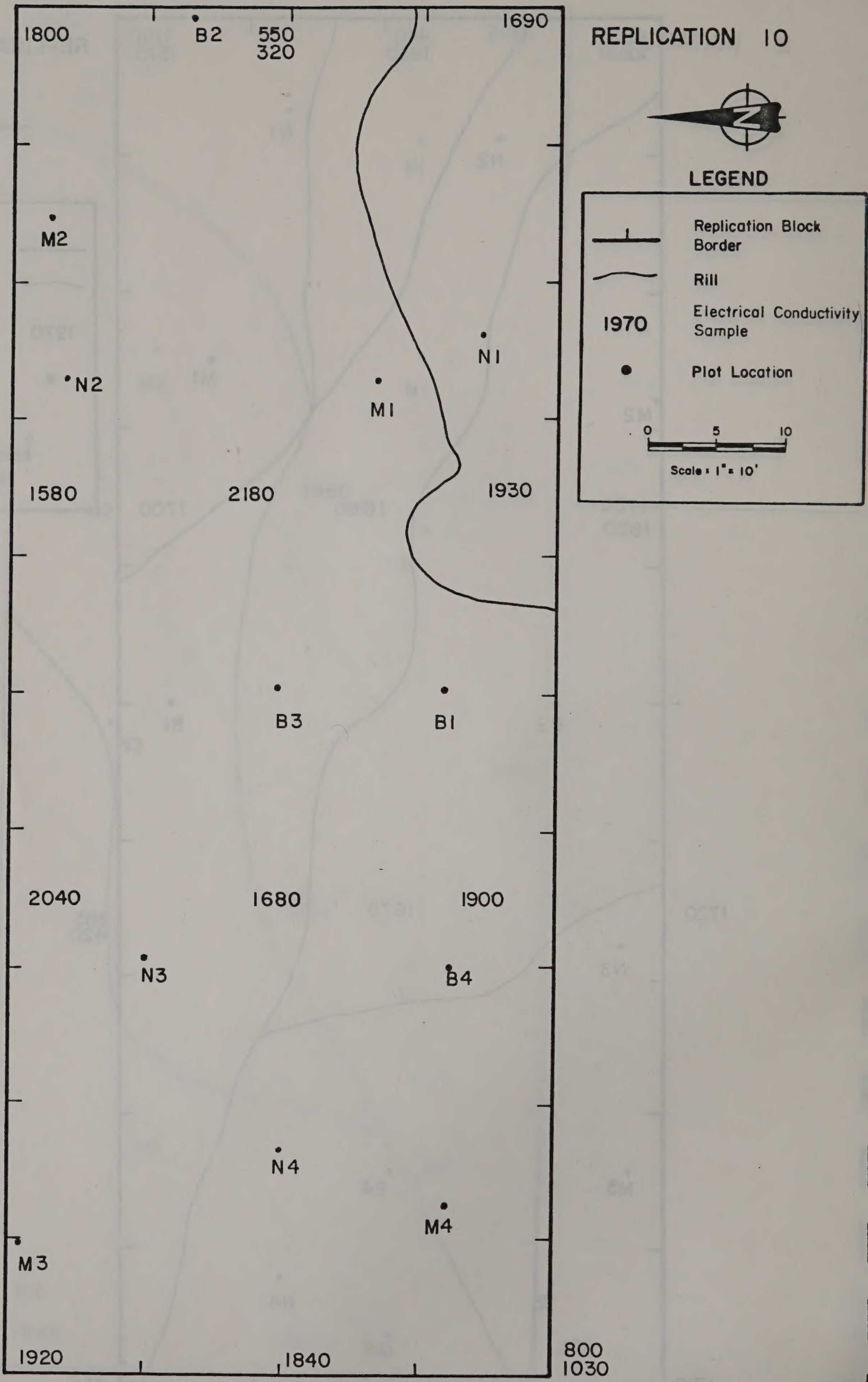
REPLICATION 8

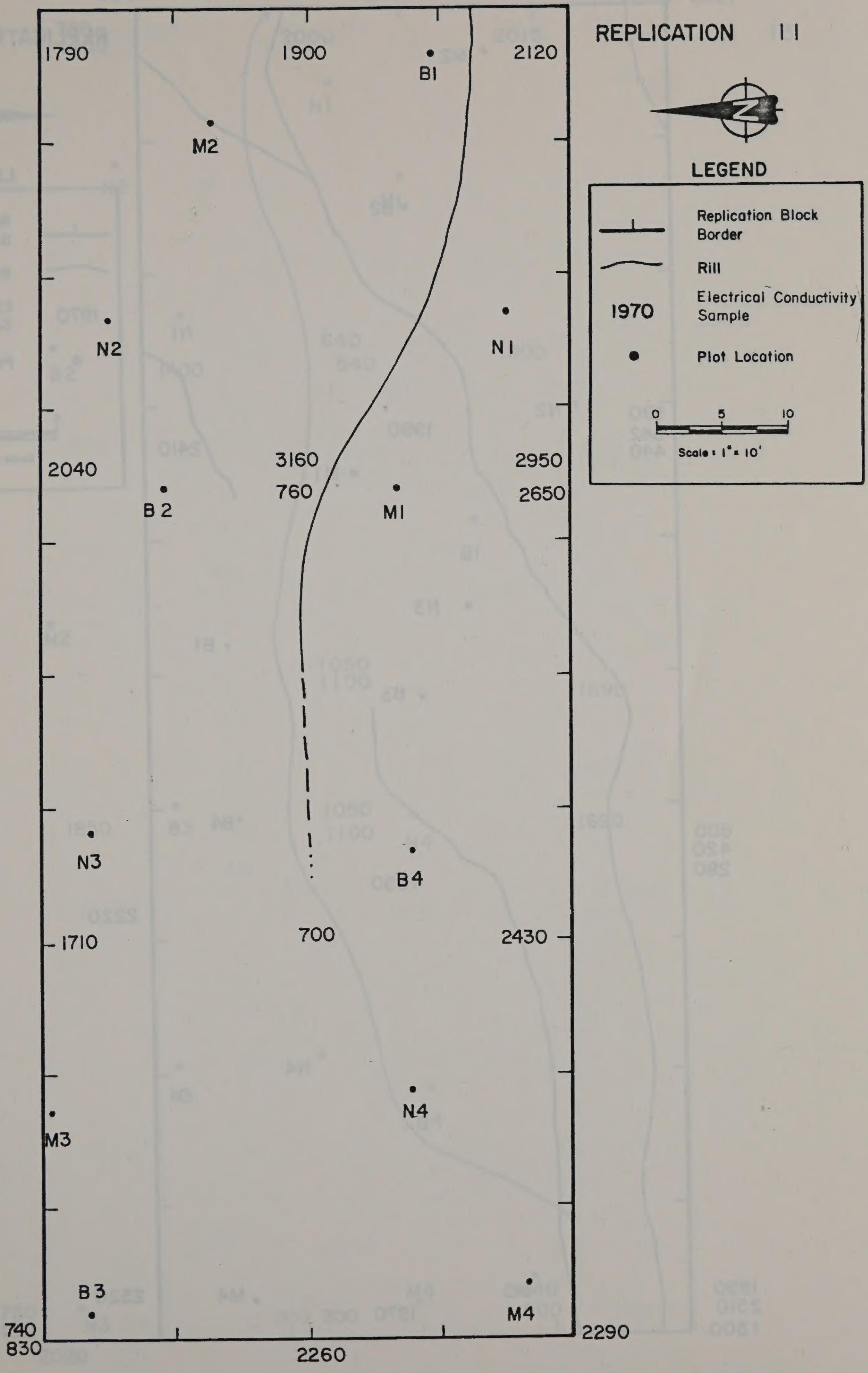


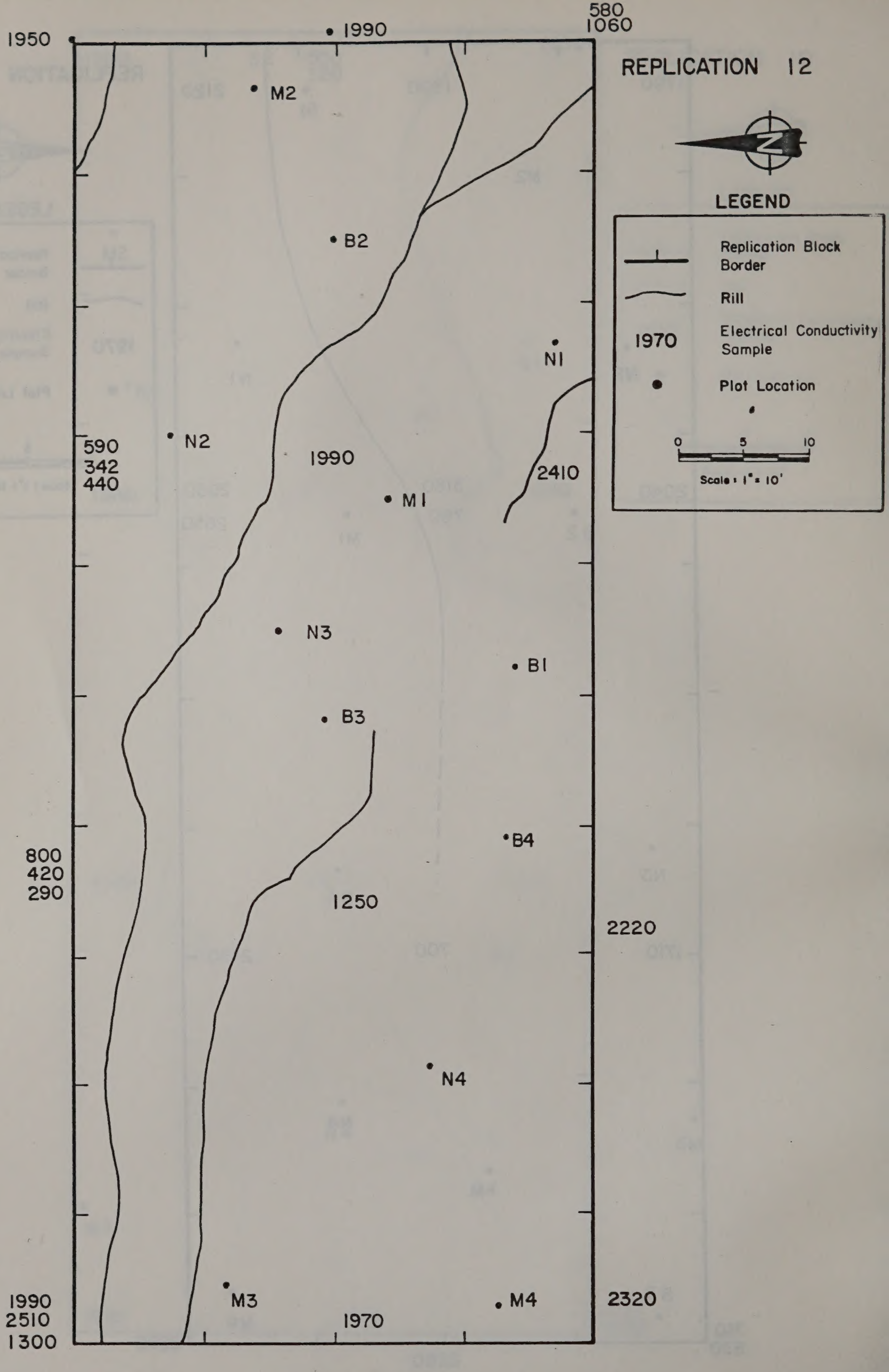
REPLICATION 9



REPLICATION 10

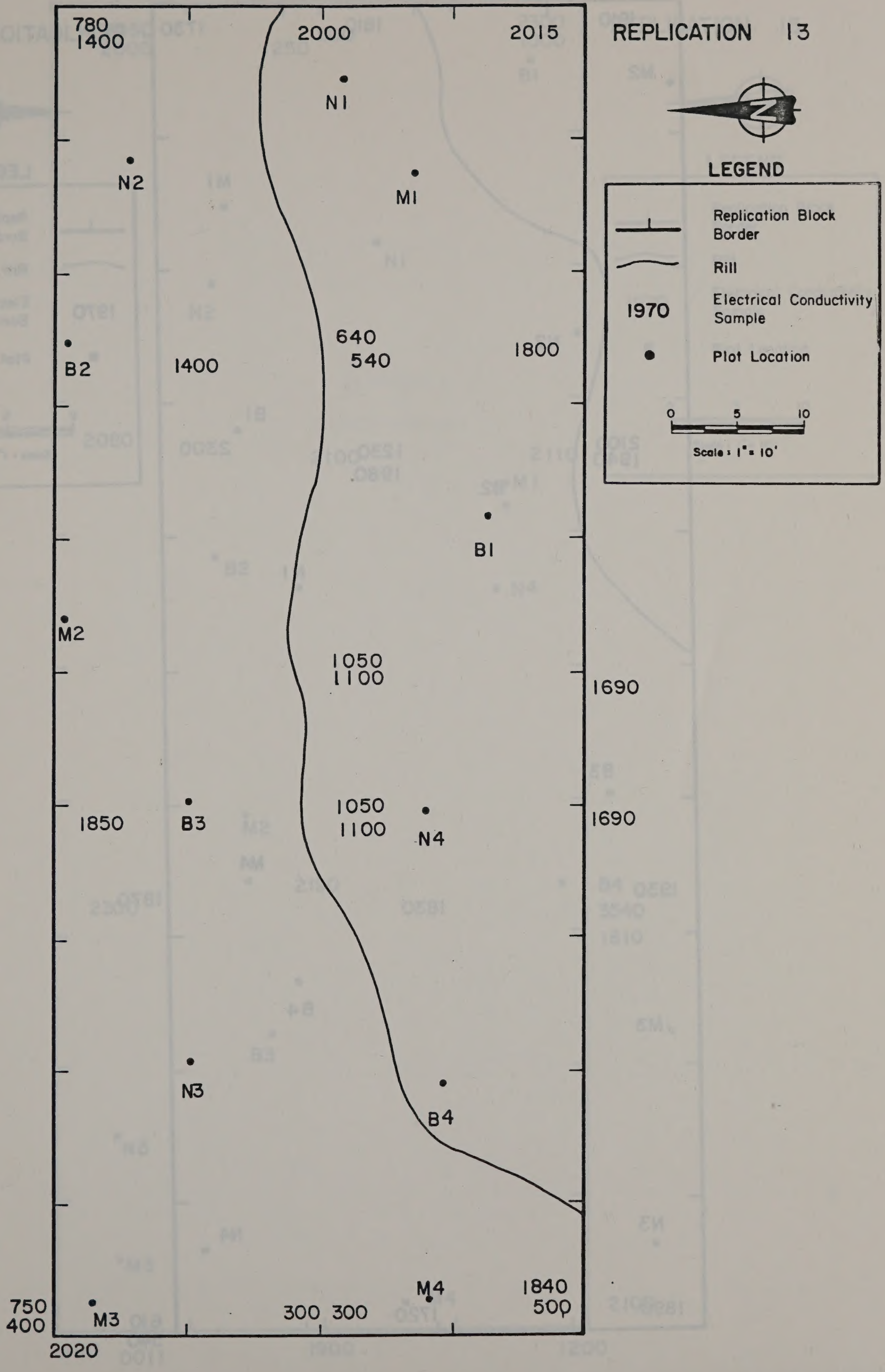



REPLICATION 11

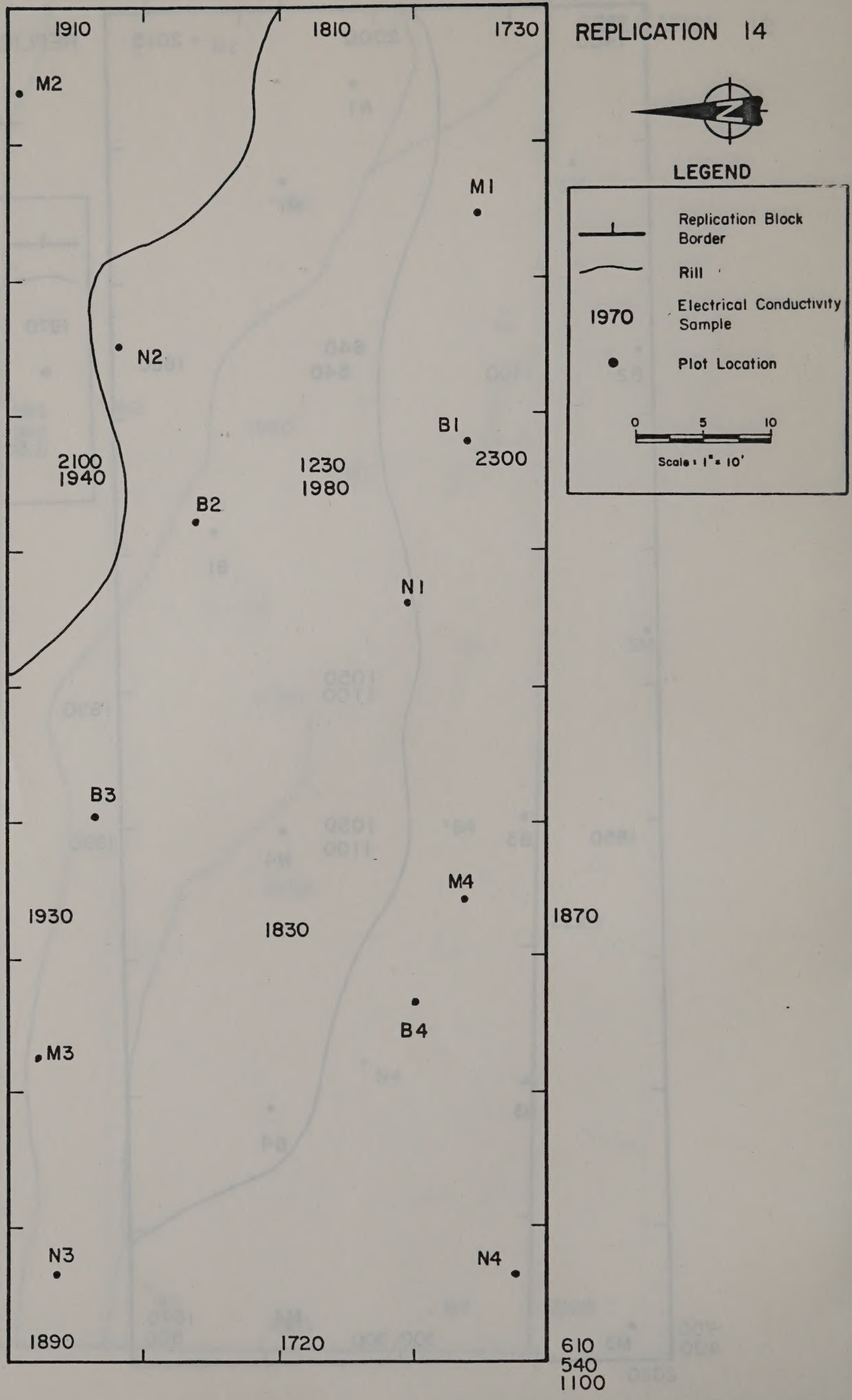


REPLICATION 12

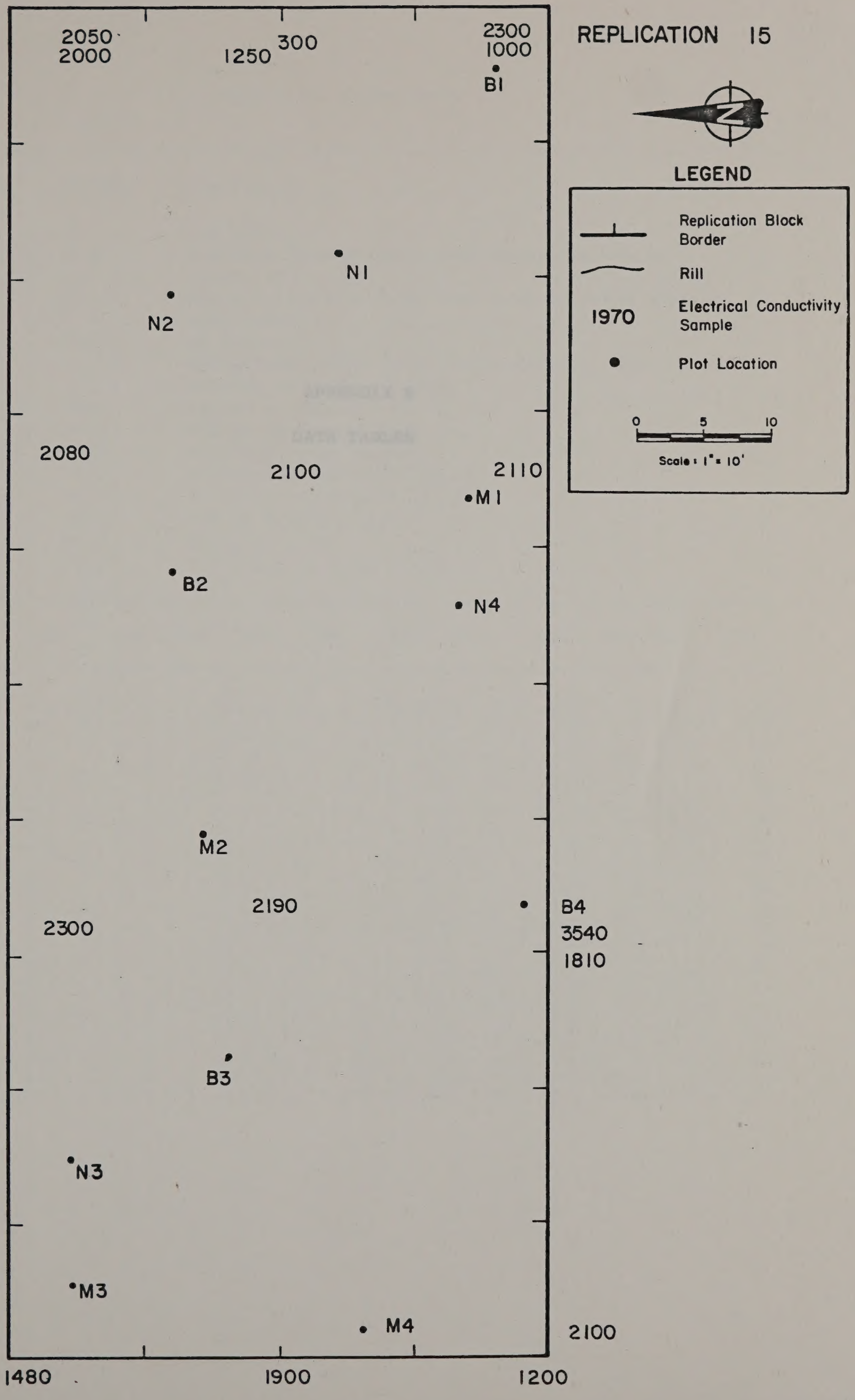
REPLICATION 13



REPLICATION 14



REPLICATION 15



APPENDIX B

DATA TABLES

Table B.1. Field Data.

Variable	Format	Description
ID	I5	Run type
EC1	F5.0	Electric Conductivity from composite sample (μmhos/cm)
EC2	F6.1	Electric Conductivity from time-weighted average (μmhos/cm)
pH	F5.1	pH reading
NQP	F5.1	Normalized runoff peak (ml/sec/cm/hr) peak runoff divided by rainfall rate
VRO	F6.0	Volume of runoff (ml)
RO	F5.2	Volume of runoff (in)
RFR	F5.2	Rainfall rate (cm/hr)
DR	F5.2	Duration of Rainfall (min)
BRO	F5.2	Beginning of Runoff (min)
ERO	F5.2	End of Runoff (min)
SLOP	F5.4	Slope of plot
INF	F5.2	Infiltration rate (in/hr)

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
1B1D	502.	431.4	8.5	1.7	15157.	1.03	5.80	31.00	1.63	31.50	.0391	.29
1B1W	348.	269.9	8.6	1.8	15177.	1.03	5.40	30.00	1.00	30.50	.0391	.07
1M1D	312.	260.9	8.5	1.3	12352.	.84	6.60	31.62	2.43	32.12	.0260	1.00
1M1W	350.	292.0	8.6	1.5	12861.	.87	5.60	30.00	1.25	30.50	.0260	.46
1N1D	280.	247.2	8.6	1.6	12894.	.87	5.20	32.17	1.40	32.67	.0443	.42
1N1W	218.	156.1	8.7	1.6	13603.	.92	5.40	30.50	1.33	31.00	.0443	.32
1B2D	503.	470.3	8.2	1.8	16217.	1.10	6.00	31.00	.92	31.50	.0573	.23
1B2W	510.	423.0	8.3	1.6	17641.	1.20	6.60	30.00	.75	30.50	.0573	.20
1M2D	226.	195.6	8.6	1.6	15535.	1.05	6.40	31.00	1.13	31.50	.0156	.49
1M2W	120.	98.5	9.0	1.6	16334.	1.11	6.10	30.00	.83	30.50	.0156	.18
1N2D	710.	621.3	8.0	1.5	14825.	1.01	6.40	31.00	1.67	31.50	.0391	.56
1N2W	471.	409.7	8.3	1.7	13169.	.89	5.04	30.00	1.10	30.50	.0391	.20
1B3D	282.	232.9	8.7	1.4	15165.	1.03	7.30	31.00	1.83	31.50	.0208	.88
1B3W	185.	192.3	8.4	1.5	16166.	1.10	7.00	30.00	1.00	30.50	.0208	.56
1M3D	1030.	926.7	8.4	1.3	13097.	.89	7.50	32.00	7.00	32.50	.0313	1.28
1M3W	840.	688.5	8.5	1.4	15941.	1.08	6.80	32.00	.75	32.50	.0313	.65
1N3D	448.	410.5	8.4	1.4	13019.	.88	6.80	31.00	3.25	31.50	.0208	.97
1N3W	338.	263.0	8.7	1.6	15734.	1.07	6.30	31.00	1.02	31.50	.0208	.41
1B4D	780.	882.5	8.4	1.5	12171.	.83	6.40	30.00	3.67	30.50	.0260	.86
1B4W	690.	682.5	8.4	1.5	15975.	1.08	6.50	30.00	.83	30.50	.0260	.40
1M4D	800.	712.1	7.7	1.3	9187.	.62	6.70	30.00	3.00	30.50	.0260	1.40
1M4W	690.	519.6	7.8	1.4	13284.	.90	6.70	30.00	1.33	30.50	.0260	.84
1N4D	530.	466.1	8.0	1.4	11669.	.79	6.70	30.00	3.25	30.50	.0156	1.06
1N4W	354.	279.2	8.1	1.6	16105.	1.09	6.60	31.00	.75	31.50	.0156	.49

Table B.1. Continued.

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
2B1D	210.	275.7	8.5	1.6	14214.	.96	6.00	32.08	2.00	32.50	.0260	.57
2B1W	230.	160.8	8.7	1.6	17501.	1.19	6.20	32.33	1.00	32.85	.0260	.23
2M1D	272.	225.5	8.6	1.6	13930.	.94	5.70	31.50	2.33	32.17	.0313	.45
2M1W	214.	231.9	8.5	1.6	14169.	.96	6.20	32.50	1.50	33.00	.0313	.67
2N1D	200.	232.6	6.4	1.4	13758.	.93	6.40	31.50	2.00	32.00	.0365	.75
2N1W	180.	133.6	8.8	1.5	13139.	.89	5.70	30.50	.83	31.00	.0365	.49
2B2D	502.	369.4	8.3	1.5	13896.	.94	6.30	30.17	1.67	30.75	.0469	.61
2B2W	480.	338.4	8.4	1.4	15781.	1.07	7.00	32.00	.67	32.33	.0469	.75
2M2D	320.	254.6	8.6	1.7	13010.	.88	5.20	31.00	1.47	31.50	.0313	.34
2M2W	215.	148.8	8.8	1.2	14225.	.96	6.80	32.17	1.00	32.50	.0313	.89
2N2D	228.	191.7	8.7	1.3	13793.	.94	6.90	30.00	1.42	30.57	.0417	.84
2N2W	165.	116.4	8.6	1.4	16677.	1.13	6.90	32.17	1.00	32.50	.0417	.61
2B3D	800.	606.8	8.4	1.4	13640.	.92	6.90	32.00	2.75	32.75	.0340	.99
2B3W	570.	546.5	8.3	1.3	14856.	1.01	6.90	30.17	1.00	31.00	.0340	.71
2M3D	282.	218.1	8.7	1.2	10706.	.73	6.90	32.00	3.00	32.58	.0260	1.35
2M3W	249.	180.7	8.5	1.4	13121.	.89	6.60	30.17	1.00	30.50	.0260	.83
2N3D	730.	588.7	8.4	1.3	11283.	.77	7.20	32.00	6.00	32.50	.0365	1.39
2N3W	550.	445.1	8.3	1.3	13008.	.88	6.60	30.00	.75	30.50	.0365	.84
2B4D	365.	271.3	7.9	1.6	13582.	.92	6.30	32.17	6.67	32.42	.0521	.76
2B4W	274.	192.2	7.9	1.5	16501.	1.12	6.80	30.17	.83	30.67	.0521	.45
2M4D	730.	571.8	7.8	1.4	10910.	.74	6.30	31.17	1.50	31.50	.0573	1.06
2M4W	450.	400.5	7.8	1.4	13612.	.92	6.30	30.00	.75	30.33	.0573	.64
2N4D	1600.	1275.7	8.3	1.5	12588.	.85	6.90	31.00	1.42	31.50	.0469	1.07
2N4W	1110.	813.1	8.2	1.5	15558.	1.05	6.60	30.17	1.00	30.50	.0469	.51
3B1D	115.	113.2	8.7	1.5	12398.	.84	5.20	31.08	2.50	31.58	.0313	.43
3B1W	178.	103.9	8.8	1.3	13469.	.91	6.40	30.10	1.25	31.25	.0313	.71
3M1D	151.	129.4	8.8	1.2	11295.	.77	5.70	32.08	3.83	32.58	.0156	.80
3M1W	184.	146.2	8.8	1.4	15525.	1.05	6.50	32.08	.92	32.58	.0156	.60
3N1D	245.	331.2	8.6	1.3	12653.	.86	6.50	31.08	2.75	31.58	.0365	.90
3N1W	324.	193.3	8.7	1.5	16710.	1.13	6.30	32.13	.83	32.63	.0365	.37
3B2D	430.	252.2	8.3	1.5	14563.	.99	7.10	30.13	1.90	30.63	.0313	.82
3B2W	380.	264.8	8.5	1.5	17692.	1.20	6.90	32.12	.92	32.62	.0313	.47
3M2D	388.	280.0	8.5	1.3	13658.	.93	6.90	31.10	2.67	31.60	.0313	.92
3M2W	343.	252.4	8.4	1.4	16944.	1.15	6.90	32.08	.83	32.58	.0313	.57
3N2D	102.	91.9	9.1	1.6	14422.	.98	6.60	30.08	1.87	30.58	.0313	.64
3N2W	69.	50.9	9.1	1.5	16895.	1.15	6.60	32.08	1.00	32.58	.0313	.45
3B3D	778.	535.8	8.1	1.4	13844.	.94	6.60	32.10	3.12	32.60	.0260	.84
3B3W	500.	372.6	8.3	1.5	17003.	1.15	6.40	32.12	.75	32.62	.0260	.37
3M3D	760.	570.4	8.4	1.0	6816.	.46	6.70	30.10	7.58	30.60	.0260	1.72
3M3W	620.	398.3	8.4	1.2	10995.	.75	6.30	32.10	3.42	32.60	.0260	1.08
3N3D	650.	405.9	8.5	1.4	9223.	.63	6.20	30.08	4.50	30.58	.0156	1.18
3N3W	448.	341.3	8.5	1.5	14221.	.96	6.30	31.08	2.50	31.58	.0156	.63
3B4D	660.	484.4	7.7	1.4	11512.	.78	6.40	30.08	3.75	30.58	.0365	.96
3B4W	495.	398.9	7.9	1.5	14954.	1.01	6.60	30.07	.92	30.57	.0365	.58
3M4D	1180.	934.8	7.7	1.3	11621.	.79	6.50	30.10	4.25	30.60	.0521	.98
3M4W	1180.	838.4	7.7	1.5	16171.	1.10	6.40	32.08	.67	32.58	.0521	.46
3N4D	440.	374.9	8.5	1.3	9672.	.66	6.80	30.10	7.75	30.60	.0417	1.36
3N4W	310.	290.7	8.4	1.4	15145.	1.03	7.00	31.10	2.25	31.60	.0417	.77

Table B.1. Continued.

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
4B4D	640.	474.9	7.7	1.3	12042.	.82	6.40	30.00	3.00	32.50	.0365	.88
4B1W	600.	506.6	7.7	1.6	15161.	1.03	6.10	30.00	.33	30.50	.0365	.34
4M1D	389.	326.1	8.0	1.2	11311.	.77	6.50	31.00	1.83	31.50	.0417	1.07
4M1W	275.	222.8	8.0	1.3	12519.	.85	6.50	30.00	.50	30.50	.0417	.86
4N1D	330.	260.0	7.9	1.4	12893.	.87	6.90	31.00	1.67	31.50	.0365	1.03
4N1W	218.	179.4	7.8	1.5	15044.	1.02	6.30	30.00	.83	30.50	.0365	.44
4B2D	228.	176.7	8.0	1.4	14422.	.98	6.40	32.10	1.17	32.60	.0260	.69
4B2W	258.	199.4	8.0	1.4	14976.	1.02	6.70	30.00	1.00	30.50	.0260	.60
4M2D	353.	309.8	7.9	1.5	13634.	.92	6.30	31.00	1.60	31.50	.0313	.70
4M2W	239.	210.2	8.0	1.4	14171.	.96	6.80	30.00	.67	30.50	.0313	.76
4N2D	264.	247.9	8.0	1.3	12019.	.81	6.50	30.00	1.75	30.50	.0104	.94
4N2W	194.	160.7	8.1	1.4	14713.	1.00	6.60	30.00	.53	30.50	.0104	.60
4B3D	135.	1245.2	7.5	1.4	13150.	.89	6.70	30.00	2.15	30.50	.0313	.86
4B3W	950.	1077.3	7.5	1.4	15458.	1.05	6.60	30.00	.50	30.50	.0313	.50
4M3D	580.	448.2	8.2	1.4	12201.	.83	6.00	28.25	2.25	28.75	.0365	.60
4M3W	440.	377.1	8.3	1.5	14743.	1.00	6.50	30.00	.78	30.50	.0365	.56
4N3D	114.	103.2	8.8	1.5	13889.	.94	6.50	30.00	.75	30.50	.0208	.68
4N3W	73.	77.0	8.9	1.5	15019.	1.02	6.30	30.00	.67	30.50	.0208	.44
4B4D	520.	474.9	8.4	1.3	12042.	.82	6.50	32.00	3.00	32.50	.0313	1.02
4B4W	600.	499.6	8.4	1.5	14778.	1.00	6.07	30.00	1.17	30.50	.0313	.39
4M4D	396.	302.7	8.3	1.3	10868.	.74	6.70	30.00	2.00	30.50	.0208	1.16
4M4W	275.	202.4	8.5	1.6	13974.	.95	6.40	30.00	1.00	30.50	.0208	.62
4N4D	1000.	956.8	8.2	1.4	11369.	.77	6.70	30.00	2.33	30.50	.0365	1.10
4N4W	820.	763.1	8.3	1.5	14180.	.96	6.50	30.00	1.00	30.50	.0365	.64
5B1D	438.	339.8	7.9	1.4	14114.	.96	6.50	30.17	1.75	30.50	.0313	.65
5B1W	342.	256.2	8.0	1.4	16301.	1.11	6.80	32.00	.75	32.45	.0313	.60
5M1D	446.	342.9	7.8	1.3	11739.	.80	5.90	31.17	2.00	31.50	.0365	.78
5M1W	356.	259.4	7.8	1.3	15190.	1.03	6.60	32.17	.75	32.50	.0365	.68
5N1D	330.	244.7	7.7	1.4	13671.	.93	6.80	31.00	2.50	31.43	.0313	.88
5N1W	272.	190.8	7.8	1.5	15269.	1.04	6.40	30.17	.58	30.50	.0313	.45
5B2D	680.	522.7	7.8	1.3	13352.	.91	6.60	31.00	2.67	31.42	.0365	.84
5B2W	520.	423.5	7.9	1.4	16239.	1.10	6.70	32.17	.58	32.42	.0365	.59
5M2D	550.	396.7	7.9	1.2	10184.	.69	6.40	30.17	4.83	30.67	.0417	1.15
5M2W	374.	293.8	8.0	1.3	14235.	.97	6.30	32.13	.47	32.63	.0417	.67
5N2D	970.	856.8	7.7	1.3	12009.	.81	6.70	30.17	4.75	30.67	.0260	1.03
5N2W	720.	641.3	7.8	1.4	14032.	.95	6.60	30.15	1.22	30.65	.0260	.71
5B3D	750.	714.0	7.6	1.3	11816.	.80	6.20	32.18	3.25	32.68	.0208	.95
5B3W	437.	416.9	7.8	1.3	13286.	.90	6.50	30.18	.78	30.68	.0208	.77
5M3D	307.	252.4	8.5	1.2	11792.	.80	6.80	33.67	7.50	34.17	.0234	1.25
5M3W	210.	183.1	8.7	1.4	14674.	.99	6.50	31.17	2.62	32.13	.0234	.65
5N3D	202.	177.0	8.5	1.3	11598.	.79	6.70	31.18	3.32	31.68	.0208	1.12
5N3W	179.	124.1	8.6	1.4	14573.	.99	7.00	30.00	.80	30.50	.0208	.78
5B4D	365.	205.1	8.4	1.4	8299.	.56	6.19	30.13	7.17	30.75	.0365	1.32
5B4W	430.	314.0	8.4	1.4	12073.	.82	6.24	30.13	3.80	30.63	.0365	.82
5M4D	490.	426.6	8.4	1.2	11491.	.78	7.30	30.15	4.42	30.65	.0521	1.32
5M4W	380.	288.2	8.5	1.5	13656.	.93	6.30	30.17	1.12	30.67	.0521	.63
5N4D	208.	149.8	8.7	1.3	7817.	.53	6.35	30.22	6.17	30.72	.0417	1.45
5N4W	136.	141.1	8.2	1.5	12707.	.86	5.66	31.17	1.80	31.67	.0417	.57

Table B.1. Continued.

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
6B1D	560.	366.6	7.7	1.4	15017.	1.02	6.80	30.10	1.50	30.60	.0833	.64
6B1W	510.	380.5	7.7	1.5	16861.	1.14	6.50	32.08	.58	32.58	.0833	.43
6M1D	303.	239.1	8.0	1.4	14059.	.95	6.70	31.08	2.00	31.58	.0313	.80
6M1W	208.	155.6	8.1	1.4	16966.	1.15	6.90	32.08	.75	32.58	.0313	.57
6N1D	269.	230.7	7.8	1.3	14438.	.98	6.80	31.08	1.92	31.58	.0417	.79
6N1W	231.	178.6	7.9	1.4	15917.	1.08	6.70	32.08	.67	32.58	.0417	.62
6B2D	294.	240.9	7.9	1.7	15198.	1.03	6.60	31.75	2.50	32.25	.0208	.65
6B2W	199.	163.0	8.2	1.4	17259.	1.17	6.80	32.08	.53	32.58	.0208	.49
6M2D	190.	155.5	8.0	1.4	13151.	.89	6.80	30.10	1.95	30.60	.0313	.90
6M2W	160.	129.2	8.1	1.4	15050.	1.02	6.70	30.10	.87	30.60	.0313	.60
6N2D	788.	300.1	7.9	1.2	9251.	.63	6.60	30.10	4.17	30.60	.0208	1.34
6N2W	339.	236.4	8.0	1.3	13681.	.93	6.70	30.08	1.50	30.58	.0208	.78
6B3D	560.	548.2	7.7	1.5	14236.	.97	6.40	32.08	2.50	32.58	.0313	.71
6B3W	610.	499.1	7.7	1.6	18562.	1.26	6.90	32.10	.67	32.60	.0208	.36
6M3D	239.	190.8	8.6	1.3	12051.	.82	7.00	31.10	4.98	31.60	.0417	1.17
6M3W	164.	171.6	8.6	1.6	15275.	1.04	6.70	30.10	1.25	30.60	.0417	.56
6N3D	471.	447.3	8.3	1.4	13196.	.89	7.50	31.10	2.92	31.60	.0729	1.24
6N3W	394.	334.9	8.4	1.3	14509.	.98	6.90	30.08	1.00	30.58	.0729	.76
6B4D	190.	171.6	8.7	1.3	11869.	.80	6.98	30.08	4.65	30.58	.0313	1.15
6B4W	168.	153.8	8.6	1.4	15577.	1.06	6.60	32.25	.73	32.75	.0313	.63
6M4D	270.	167.6	8.5	1.2	11658.	.79	6.99	30.10	4.25	30.60	.0365	1.18
6M4W	322.	248.1	8.6	1.4	15702.	1.06	6.97	30.10	1.42	30.60	.0365	.63
6N4D	400.	356.4	8.4	1.5	11746.	.80	6.60	30.10	4.67	30.60	.0365	1.00
6N4W	292.	257.2	8.6	1.7	14969.	1.01	6.20	30.10	1.75	30.60	.0365	.43
7B1D	169.	152.0	8.7	1.5	15452.	1.05	6.30	31.00	2.00	31.50	.0365	.45
7B1W	127.	99.1	8.8	1.5	15607.	1.06	6.20	30.00	.75	30.50	.0365	.32
7M1D	251.	222.5	8.7	1.2	12161.	.82	6.50	32.00	1.67	32.50	.0313	1.02
7M1W	172.	142.9	8.9	1.4	14010.	.95	6.30	30.00	.58	30.50	.0313	.58
7N1D	242.	234.5	8.4	1.5	14333.	.97	6.40	31.00	1.50	31.50	.0391	.64
7N1W	151.	128.8	8.8	1.5	16225.	1.10	6.60	30.00	.75	30.50	.0391	.40
7B2D	1028.	840.5	8.2	1.4	13146.	.89	6.60	30.00	1.33	30.50	.0260	.82
7B2W	820.	686.1	8.6	1.4	15294.	1.04	6.60	30.00	.50	30.50	.0260	.52
7M2D	650.	608.7	8.1	1.3	11799.	.80	6.50	30.00	2.67	30.50	.0625	.96
7M2W	800.	639.1	8.2	2.0	14156.	.96	6.50	30.00	.72	30.50	.0625	.64
7N2D	237.	236.6	8.3	1.4	13164.	.89	6.40	30.00	2.17	30.50	.0625	.74
7N2W	298.	273.3	8.4	1.4	14299.	.97	6.40	30.00	.83	30.50	.0625	.58
7B3D	1090.	875.4	7.9	1.5	11753.	.80	5.80	30.00	2.50	30.50	.0313	.68
7B3W	900.	698.8	8.3	1.6	14826.	1.01	5.80	30.00	1.00	30.50	.0313	.26
7M3D	306.	251.0	8.7	1.4	12827.	.87	6.70	30.00	1.67	30.50	.0625	.90
7M3W	231.	188.4	8.8	1.4	14974.	1.02	6.70	30.00	.68	30.50	.0625	.60
7N3D	590.	467.8	8.5	1.3	11459.	.78	6.70	29.50	2.67	30.00	.0938	1.05
7N3W	765.	611.8	8.4	1.4	15541.	1.05	6.60	31.00	.83	31.50	.0938	.57
7B4D	670.	525.4	7.8	1.5	11566.	.78	6.20	30.00	2.33	30.50	.0521	.88
7B4W	755.	655.6	8.4	1.5	15910.	1.08	6.80	30.00	.67	30.50	.0521	.52
7M4D	1800.	1369.0	8.2	1.0	7155.	.49	6.80	30.00	6.25	30.50	.0417	1.70
7M4W	1460.	1104.1	8.3	1.2	12945.	.88	7.10	30.00	1.33	30.50	.0417	1.04
7N4D	645.	540.2	8.4	1.3	10317.	.70	6.70	30.00	3.00	30.50	.0313	1.24
7N4W	470.	392.0	8.4	1.4	14460.	.98	6.90	30.00	.83	30.50	.0313	.76

Table B.1. Continued.

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
8B1D	380.	296.5	8.6	1.4	13600.	.92	6.10	31.17	2.03	31.67	.0521	.63
8B1W	391.	330.9	8.5	1.5	15595.	1.06	5.90	32.17	.77	32.67	.0521	.35
8M1D	196.	151.4	8.7	1.1	12252.	.83	6.50	31.15	2.00	31.50	.0573	.96
8M1W	163.	127.3	8.8	1.2	14990.	1.02	7.40	32.17	.75	32.67	.0573	1.01
8N1D	270.	219.0	8.4	1.2	13037.	.88	6.90	31.17	1.75	31.58	.0573	1.02
8N1W	189.	149.5	8.5	1.2	14649.	.99	6.70	32.13	.78	32.52	.0573	.79
8B2D	251.	211.9	8.6	1.3	11863.	.80	6.10	31.15	1.92	31.75	.0469	.86
8B2W	174.	124.4	8.8	1.3	14647.	.99	6.60	32.13	.67	32.75	.0469	.75
8M2D	495.	473.2	7.7	1.3	13032.	.88	6.60	32.15	2.67	32.83	.0521	.96
8M2W	550.	471.4	8.0	1.5	14929.	1.01	6.50	30.17	1.08	30.92	.0521	.55
8N2D	402.	328.1	8.3	1.2	10553.	.72	5.80	32.12	3.00	32.80	.0469	.94
8N2W	320.	222.2	8.2	1.3	13165.	.89	6.40	30.15	.92	30.92	.0469	.75
8B3D	458.	337.8	8.6	1.4	10768.	.73	6.00	32.17	5.42	32.83	.0313	1.00
8B3W	460.	346.3	8.4	1.4	12222.	.83	5.90	30.03	.97	30.33	.0313	.66
8M3D	75.	55.7	8.4	1.7	13386.	.91	5.70	32.17	4.00	33.00	.0313	.55
8M3W	78.	56.5	9.1	1.4	13286.	.90	6.00	31.17	2.08	32.10	.0313	.63
8N3D	700.	581.3	7.9	1.2	10856.	.74	6.10	31.15	2.50	32.00	.0521	.98
8N3W	590.	443.5	8.3	1.4	12955.	.88	6.20	30.15	1.00	30.92	.0521	.69
8B4D	225.	155.5	8.8	1.2	8668.	.59	6.80	30.15	6.50	31.00	.0313	1.50
8B4W	170.	116.7	8.9	1.4	13756.	.93	6.50	30.12	1.33	31.00	.0313	.71
8M4D	1025.	851.5	7.8	1.5	11465.	.78	5.90	31.17	5.67	31.83	.0234	.82
8M4W	1045.	892.4	8.3	1.4	14554.	.99	6.50	30.15	.92	30.75	.0234	.59
8N4D	245.	195.4	8.7	1.4	8542.	.58	5.40	31.13	8.00	31.58	.0339	1.01
8N4W	160.	121.7	8.9	1.7	12281.	.83	5.30	29.70	1.75	30.58	.0339	.41
9B1D	550.	417.4	8.6	1.7	16496.	1.12	6.30	31.10	2.25	31.60	.0469	.32
9B1W	700.	566.9	8.6	1.7	18257.	1.24	6.40	30.25	.70	30.75	.0469	.06
9M1D	422.	312.0	8.6	1.3	13989.	.95	6.90	31.08	1.75	31.58	.0365	.88
9M1W	317.	236.9	8.5	1.4	16813.	1.14	6.90	32.08	.68	32.58	.0365	.58
9N1D	580.	486.3	8.4	1.4	14903.	1.01	7.30	30.12	1.50	30.62	.0469	.86
9N1W	720.	555.3	8.3	1.5	14583.	.99	6.20	30.10	1.00	30.60	.0469	.47
9B2D	660.	515.4	7.9	1.4	14951.	1.01	6.90	31.08	2.42	31.67	.0286	.77
9B2W	610.	485.8	7.9	1.5	16819.	1.14	6.80	32.08	.83	32.67	.0286	.54
9M2D	790.	695.3	7.7	1.6	16467.	1.12	7.40	30.10	1.50	30.50	.0156	.68
9M2W	770.	649.2	7.6	1.6	16693.	1.13	6.90	30.10	1.08	30.50	.0156	.46
9N2D	411.	327.6	8.4	1.4	11799.	.80	6.20	32.08	2.33	32.58	.0833	.94
9N2W	293.	234.8	8.5	1.4	13819.	.94	6.20	31.08	.93	31.58	.0833	.63
9B3D	1225.	1086.5	8.4	1.3	13314.	.90	7.30	31.10	5.00	31.50	.0469	1.14
9B3W	1110.	976.9	8.4	1.3	15167.	1.03	7.10	30.10	1.50	30.50	.0469	.74
9M3D	243.	203.8	8.2	1.6	13268.	.90	5.90	32.25	5.92	33.00	.0313	.65
9M3W	225.	191.4	8.9	1.8	14795.	1.00	5.80	30.10	1.50	30.55	.0313	.29
9N3D	930.	778.1	8.1	1.5	13625.	.92	6.70	30.25	4.50	30.75	.0938	.81
9N3W	930.	699.9	8.2	1.4	15776.	1.07	7.00	30.10	1.17	30.50	.0938	.62
9B4D	565.	464.5	8.0	1.3	10539.	.71	6.60	30.10	4.50	30.50	.0417	1.18
9B4W	680.	528.9	8.5	1.6	15990.	1.08	6.50	30.10	1.50	30.58	.0417	.41
9M4D	320.	262.6	8.6	1.2	7920.	.54	6.40	32.10	11.50	32.50	.0234	1.51
9M4W	287.	229.0	8.8	1.5	13929.	.94	6.50	30.10	1.75	30.58	.0234	.69
9N4D	880.	769.8	8.3	1.4	11773.	.80	6.80	30.10	4.25	30.50	.0677	1.08
9N4W	955.	816.7	8.6	1.4	14240.	.97	6.50	30.10	1.25	30.50	.0677	.63

Table B.1. Continued.

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
10B1D	246.	193.5	7.7	1.3	11093.	.75	5.90	30.00	1.83	30.50	.0313	.82
10B1W	168.	140.7	7.9	1.4	14363.	.97	6.30	30.00	.67	30.50	.0313	.54
10M1D	496.	480.9	8.5	1.2	13367.	.91	7.20	31.00	1.83	31.50	.0521	1.07
10M1W	416.	373.6	8.6	1.3	14093.	.96	6.70	30.00	.67	30.50	.0521	.72
10N1D	453.	375.8	7.8	1.5	14451.	.98	6.30	32.00	2.50	32.50	.0417	.64
10N1W	705.	542.5	8.2	1.4	14516.	.98	6.60	30.00	1.17	30.50	.0417	.64
10B2D	369.	292.7	7.6	1.3	12274.	.83	6.70	30.00	1.75	30.50	.0417	.98
10B2W	212.	183.6	7.8	1.2	13945.	.95	7.00	30.00	.67	30.50	.0417	.86
10M2D	810.	727.9	7.9	1.4	12282.	.83	6.70	30.00	2.25	30.50	.0573	.98
10M2W	1030.	874.4	7.9	1.3	13654.	.93	6.60	30.00	.75	30.50	.0573	.74
10N2D	370.	318.1	8.4	1.2	12077.	.82	7.00	31.00	2.42	31.50	.0208	1.17
10N2W	266.	238.1	8.5	1.3	14324.	.97	6.90	30.00	.92	30.50	.0208	.78
10B3D	326.	260.7	8.2	1.4	11663.	.79	6.30	30.10	2.00	30.60	.0365	.91
10B3W	399.	310.7	8.5	1.5	14031.	.95	6.30	30.10	.60	30.60	.0365	.59
10M3D	357.	295.3	8.0	1.2	10875.	.74	6.40	32.00	2.33	33.82	.0208	1.13
10M3W	253.	214.7	8.8	1.4	14104.	.96	6.20	32.00	.92	33.15	.0208	.64
10N3D	760.	537.0	8.2	1.1	8831.	.60	6.70	30.10	2.25	32.50	.0365	1.44
10N3W	412.	364.2	8.4	1.3	12935.	.88	6.70	30.10	1.00	31.83	.0365	.88
10B4D	321.	264.4	8.6	1.3	9042.	.61	6.40	30.00	4.83	30.73	.0208	1.30
10B4W	427.	267.4	8.5	1.3	9734.	.66	6.30	30.00	2.25	30.67	.0208	1.16
10M4D	466.	408.3	8.5	1.1	8223.	.56	6.60	30.10	4.87	31.45	.0260	1.48
10M4W	331.	271.0	8.3	1.2	11430.	.78	6.20	30.08	1.17	31.08	.0260	.89
10N4D	437.	353.9	8.2	1.2	9858.	.67	7.00	30.10	4.50	31.05	.0234	1.42
10N4W	430.	353.0	8.5	1.2	12358.	.84	6.70	30.08	.90	31.43	.0234	.96
11B1D	220.	164.7	8.2	1.4	14942.	1.01	6.60	31.18	2.08	31.50	.0417	.65
11B1W	320.	244.1	8.6	1.6	14913.	1.01	5.60	32.13	.92	32.83	.0417	.32
11M1D	149.	125.1	7.8	1.4	12612.	.86	6.20	32.12	2.50	32.75	.0313	.83
11M1W	103.	87.4	8.1	1.4	15108.	1.02	6.60	32.13	.67	33.00	.0313	.69
11N1D	350.	267.8	8.7	1.1	10190.	.69	6.40	32.13	3.50	32.50	.0417	1.23
11N1W	245.	201.3	8.7	1.1	12478.	.85	7.10	30.13	1.00	30.75	.0417	1.10
11B2D	1180.	922.8	8.1	1.3	10067.	.68	6.20	32.13	3.00	32.75	.0469	1.17
11B2W	1040.	911.3	8.2	1.4	15145.	1.03	6.90	32.17	.83	32.75	.0469	.80
11M2D	610.	473.7	7.6	1.2	8828.	.60	5.30	30.12	2.83	30.75	.0313	.89
11M2W	432.	354.3	7.8	1.3	15341.	1.04	6.90	32.13	.83	32.58	.0313	.77
11N2D	451.	394.1	8.0	1.3	12305.	.83	6.40	32.15	3.00	32.67	.0521	.97
11N2W	400.	327.7	8.2	1.4	12829.	.87	5.90	30.12	1.17	31.08	.0521	.59
11B3D	216.	176.7	8.1	1.4	10930.	.74	6.00	32.17	3.17	33.50	.0260	.98
11B3W	167.	132.6	8.9	1.5	14245.	.97	6.40	30.17	1.00	31.17	.0260	.59
11M3D	152.	114.5	8.9	1.3	12426.	.84	6.50	31.13	4.83	32.08	.0208	.94
11M3W	103.	76.6	9.1	1.4	15637.	1.06	6.90	32.33	.92	32.92	.0208	.75
11N3D	187.	164.0	8.5	1.5	13173.	.89	5.90	32.22	3.42	33.00	.0260	.67
11N3W	165.	127.8	8.8	1.3	13921.	.94	6.40	30.15	1.17	30.92	.0260	.65
11B4D	290.	212.5	8.7	1.0	6628.	.45	6.50	32.13	4.00	32.50	.0208	1.72
11B4W	655.	425.7	8.4	1.5	10801.	.73	5.50	30.17	2.50	30.83	.0208	.71
11M4D	1095.	929.6	8.2	1.2	10896.	.74	6.60	31.18	3.33	32.00	.0365	1.17
11M4W	950.	774.6	8.2	1.5	13521.	.92	6.20	30.17	1.50	30.67	.0365	.61
11N4D	324.	282.6	8.1	1.3	11735.	.80	6.70	32.15	5.50	33.00	.0234	1.14
11N4W	273.	212.3	8.7	1.4	14091.	.96	6.70	30.13	1.42	31.00	.0234	.73

Table B.1. Continued.

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
12B1D	118.	86.4	8.2	1.6	15478.	1.05	6.50	31.13	2.17	31.42	.0313	.54
12B1W	142.	69.4	8.2	1.4	13391.	.91	6.80	30.10	1.00	30.58	.0313	.86
12M1D	700.	645.9	8.5	1.4	12862.	.87	6.60	30.10	3.75	30.58	.0052	.86
12M1W	585.	488.2	8.6	1.4	14021.	.95	6.90	30.08	1.58	30.67	.0052	.82
12N1D	228.	178.3	8.1	1.4	10232.	.69	6.20	30.12	7.00	30.42	.0417	1.07
12N1W	400.	308.0	8.5	1.3	12843.	.87	6.30	30.10	1.25	30.42	.0417	.75
12B2D	245.	206.1	8.2	1.4	15535.	1.05	7.10	32.12	3.25	32.42	.0417	.83
12B2W	228.	189.6	8.4	1.4	16707.	1.13	6.70	32.10	.75	32.33	.0417	.53
12M2D	294.	252.3	7.7	1.3	14516.	.98	7.20	31.10	2.75	31.58	.0260	.94
12M2W	232.	197.2	7.8	1.3	15390.	1.04	7.60	30.08	1.00	30.58	.0260	.92
12N2D	236.	178.9	8.6	1.3	13864.	.94	7.10	32.10	3.42	32.42	.0234	1.04
12N2W	175.	136.1	8.7	1.3	16565.	1.12	7.50	32.08	.67	32.42	.0234	.86
12B3D	165.	111.6	8.8	1.2	12698.	.86	7.50	30.10	4.33	30.42	.0130	1.24
12B3W	108.	77.3	8.9	1.3	15145.	1.03	7.20	30.08	1.17	30.42	.0130	.78
12M3D	728.	635.3	7.9	1.3	11116.	.75	6.60	30.12	4.67	30.58	.0677	1.10
12M3W	700.	587.9	8.5	1.4	14567.	.99	6.90	30.10	1.17	30.58	.0260	.74
12N3D	398.	344.9	8.4	1.2	12632.	.86	7.40	30.12	4.17	30.42	.0313	1.20
12N3W	400.	283.6	8.5	1.4	13333.	.90	6.10	30.10	1.33	30.50	.0313	.61
12B4D	379.	331.5	8.6	1.3	12803.	.87	7.10	31.10	5.50	31.33	.0313	1.12
12B4W	795.	628.7	8.4	1.2	10139.	.69	6.40	30.77	1.33	31.33	.0313	1.17
12M4D	705.	578.4	8.3	1.2	10529.	.71	7.20	30.10	7.50	30.50	.0078	1.42
12M4W	695.	533.7	8.3	1.3	12635.	.86	6.60	30.12	1.83	30.50	.0078	.89
12N4D	905.	746.0	7.9	1.0	9835.	.67	7.30	31.12	5.83	31.33	.0521	1.58
12N4W	865.	631.8	8.3	1.3	13184.	.89	7.00	30.10	1.42	30.42	.0521	.98
13B1D	249.	193.4	8.5	1.5	14169.	.96	6.50	30.00	1.75	31.20	.0208	.64
13B1W	138.	109.6	8.9	1.5	15681.	1.06	6.30	30.07	.50	31.25	.0208	.37
13M1D	855.	711.4	8.2	1.3	11945.	.81	6.70	30.00	3.00	30.80	.0417	1.02
13M1W	845.	693.3	8.4	1.2	14471.	.98	7.20	30.00	.83	30.83	.0417	.87
13N1D	487.	419.0	8.2	1.3	13709.	.93	6.30	32.50	2.25	33.00	.0313	.76
13N1W	420.	312.7	8.4	1.3	13487.	.91	6.10	30.00	.70	30.60	.0313	.58
13B2D	805.	656.9	8.4	1.5	12833.	.87	5.80	30.00	3.00	31.35	.0260	.54
13B2W	785.	640.6	8.3	1.4	15877.	1.08	7.10	30.00	1.08	30.80	.0260	.64
13M2D	1285.	687.3	8.3	1.3	13937.	.94	7.40	30.00	1.83	30.67	.0677	1.03
13M2W	805.	642.1	8.3	1.4	14567.	.99	6.80	30.00	1.00	30.90	.0677	.70
13N2D	790.	683.2	8.4	1.4	12277.	.83	6.40	30.08	2.48	30.95	.0313	.86
13N2W	558.	457.2	8.5	1.3	13615.	.92	6.50	30.07	.73	30.83	.0313	.72
13B3D	332.	246.2	8.1	1.4	11603.	.79	6.30	30.10	2.53	31.00	.0417	.91
13B3W	219.	183.4	8.8	1.9	15233.	1.03	5.40	30.08	.90	30.78	.0417	.07
13M3D	330.	300.9	8.4	1.2	12608.	.85	7.00	32.00	2.08	33.97	.0313	1.16
13M3W	207.	192.1	8.7	1.4	14318.	.97	6.30	30.00	1.25	30.50	.0313	.54
13N3D	321.	236.4	8.5	1.2	9054.	.61	6.40	30.08	3.00	31.08	.0208	1.30
13N3W	217.	147.1	8.6	1.4	13938.	.95	6.50	30.10	1.33	31.15	.0208	.67
13B4D	278.	237.6	8.2	1.4	11380.	.77	6.00	30.08	3.67	32.65	.0365	.83
13B4W	228.	203.5	8.8	1.5	14647.	.99	6.00	30.10	1.05	31.67	.0365	.39
13M4D	1250.	815.9	8.2	1.3	10243.	.69	6.80	30.10	1.75	31.77	.0260	1.30
13M4W	810.	699.4	8.3	1.3	13323.	.90	6.60	30.10	.83	30.75	.0260	.80
13N4D	610.	432.7	8.4	1.2	9574.	.65	6.60	32.00	3.60	33.00	.0208	1.38
13N4W	506.	445.3	8.3	1.4	13817.	.94	6.50	31.00	1.50	32.03	.0208	.74

Table B.1. Continued.

ID	EC1	EC2	pH	NQP	VRO	RO	RFR	DR	BRO	ERO	SLOP	INF
14B1D	249.	175.3	8.7	1.4	15384.	1.04	6.90	31.13	2.00	32.00	.0313	.71
14B1W	201.	148.3	8.7	1.5	17203.	1.17	6.60	32.12	.67	32.50	.0313	.41
14M1D	293.	258.0	8.2	1.4	12630.	.86	5.90	31.15	2.00	32.00	.0313	.67
14M1W	575.	410.7	8.3	1.4	15420.	1.05	6.30	32.13	.75	32.67	.0313	.52
14N1D	340.	302.4	8.5	1.3	13552.	.92	6.80	31.17	2.33	31.67	.0156	.91
14N1W	156.	131.3	8.9	1.4	15311.	1.04	6.40	32.12	.75	33.00	.0156	.58
14B2D	145.	112.6	8.8	1.3	13791.	.94	6.60	32.13	2.33	32.67	.0469	.84
14B2W	115.	92.6	9.1	1.3	15667.	1.06	6.70	32.10	.75	32.58	.0469	.66
14M2D	440.	383.4	8.5	1.3	13563.	.92	6.70	31.13	2.25	32.25	.0208	.86
14M2W	347.	293.5	8.6	1.6	16516.	1.12	6.20	32.12	.88	32.83	.0208	.35
14N2D	282.	210.4	8.5	1.2	10490.	.71	6.60	30.35	4.17	30.75	.0208	1.19
14N2W	217.	172.5	8.5	1.4	13810.	.94	6.30	30.13	1.38	30.92	.0208	.61
14B3D	264.	241.6	8.4	1.2	12319.	.84	7.10	32.15	2.83	32.75	.0313	1.23
14B3W	230.	190.3	9.0	1.5	15622.	1.06	7.10	32.17	.80	32.67	.0313	.82
14M3D	231.	199.1	8.7	1.4	10098.	.68	5.90	31.13	5.83	31.83	.0208	1.01
14M3W	205.	155.1	8.8	1.3	13280.	.90	6.20	32.13	.92	32.67	.0208	.76
14N3D	213.	178.1	8.3	1.0	9532.	.65	7.10	30.15	3.22	30.60	.0313	1.50
14N3W	169.	138.1	8.9	1.4	13616.	.92	6.50	30.17	1.00	30.83	.0313	.73
14B4D	573.	503.5	8.1	1.4	10942.	.74	6.90	31.17	5.67	32.00	.0156	1.29
14B4W	428.	329.0	8.7	1.3	14408.	.98	7.40	30.17	.85	30.67	.0156	.96
14M4D	1085.	870.0	8.3	1.2	8293.	.56	6.20	31.17	5.50	31.75	.0286	1.36
14M4W	1065.	798.4	8.4	1.5	14378.	.97	6.40	30.25	.75	31.00	.0286	.60
14N4D	399.	311.7	8.6	1.0	7623.	.52	6.70	30.13	5.50	31.00	.0260	1.60
14N4W	242.	202.6	8.8	1.0	11511.	.78	7.10	30.17	1.78	30.67	.0260	1.24
15B1D	144.	119.9	8.6	1.4	13072.	.89	5.60	31.10	2.50	31.42	.0313	.49
15B1W	424.	317.3	8.4	1.6	14567.	.99	5.90	30.10	1.67	30.42	.0313	.35
15M1D	400.	349.8	8.5	1.2	12219.	.83	6.20	31.10	2.83	31.42	.0469	.84
15M1W	322.	282.0	8.7	1.7	13485.	.91	6.50	30.10	1.17	30.58	.0469	.75
15N1D	231.	207.3	8.7	1.3	12011.	.81	6.70	31.08	2.42	31.42	.0417	1.07
15N1W	155.	128.3	8.9	1.2	14802.	1.00	7.00	32.33	.83	32.58	.0417	.90
15B2D	229.	196.9	8.7	1.5	12454.	.84	5.90	31.10	2.33	31.58	.0313	.70
15B2W	166.	145.7	8.8	1.6	14762.	1.00	5.80	31.10	2.50	31.58	.0313	.35
15M2D	342.	310.9	8.5	1.3	13093.	.89	6.80	32.08	3.42	32.50	.0182	1.01
15M2W	286.	223.5	8.5	1.4	13406.	.91	6.40	30.08	1.00	30.42	.0182	.70
15N2D	386.	324.7	8.6	1.2	11748.	.80	7.00	32.08	3.67	32.42	.0417	1.26
15N2W	220.	181.9	8.8	1.2	14721.	1.00	7.40	32.08	.92	32.50	.0417	1.04
15B3D	1230.	1062.9	8.3	1.3	11649.	.79	6.80	30.20	4.83	30.50	.0573	1.11
15B3W	1300.	1096.4	8.4	1.4	14441.	.98	6.70	30.10	1.50	30.08	.0573	.68
15M3D	468.	372.1	8.1	1.2	12440.	.84	7.90	30.10	4.75	30.67	.0260	1.44
15M3W	431.	353.7	8.6	1.4	11662.	.79	5.70	31.10	2.83	31.50	.0260	.72
15N3D	463.	357.8	8.2	1.6	11100.	.75	6.60	30.12	7.00	30.83	.0026	1.10
15N3W	322.	271.0	8.6	1.6	13929.	.94	6.20	30.10	1.50	30.67	.0026	.57
15B4D	123.	104.5	8.5	1.4	13124.	.89	6.10	32.08	3.50	32.58	.0365	.74
15B4W	77.	57.8	9.3	1.9	14704.	1.00	5.61	30.10	1.83	30.50	.0365	.22
15M4D	466.	408.9	8.5	1.3	10440.	.71	6.70	30.08	4.17	30.42	.0286	1.22
15M4W	406.	354.2	8.7	1.3	14309.	.97	7.13	30.08	1.03	30.42	.0286	.87
15N4D	466.	368.7	8.5	1.0	9551.	.65	7.80	30.08	7.25	30.58	.0286	1.77
15N4W	311.	258.1	8.4	1.1	12902.	.87	7.20	31.08	2.33	31.50	.0286	1.16

Table B.2. Resources Characterization Data.

Variable	Format	Description
ID	I5	Plot Type
VEGP	F5.1	Vegetative cover from the point method, in percent
TLITP	F5.1	Litter cover from the point method, in percent
ROCKP	F5.1	Rock cover from the point method, in percent
TCOVP	F5.1	Total cover from the point method, in percent
TBARP	F5.1	Total bare ground from the point method, in percent
DISP	F5.1	Disturbed bare ground from the point method, in percent
VEGC	F5.1	Vegetative cover from the cell method, in percent
TLITC	F5.1	Litter cover from the cell method, in percent
ROCKC	F5.1	Rock cover from the cell method, in percent
TCOVC	F5.1	Total cover from the cell method, in percent
TBARC	F5.1	Total bare ground from the cell method, in percent
DISC	F5.1	Disturbed bare ground from the cell method, in percent
DIA	F5.1	Plant diameter, inches
HEI	F5.1	Plant height, inches
MOU	I5	Mounding category

ID	VEGP	TLITP	ROCKP	TCOVP	TBARP	DISP	VEGC	TLITC	ROCKC	TCOVC	TBARC	DISC	DIA	HEI	MOU
1B1	0.0	8.0	2.0	10.0	90.0	0.0	0.0	3.8	2.6	6.4	93.6	0.0	0.0	0.0	0
2B1	0.0	3.0	2.0	5.0	95.0	0.0	0.0	2.8	4.0	6.8	93.2	0.0	0.0	0.0	0
3B1	0.0	14.0	5.0	19.0	81.0	0.0	0.0	16.5	5.5	22.0	78.0	0.0	0.0	0.0	0
4B1	0.0	11.0	7.0	18.0	82.0	0.0	0.0	10.0	7.8	17.8	82.2	0.0	0.0	0.0	0
5B1	0.0	6.0	2.0	8.0	92.0	0.0	0.0	9.5	4.5	14.0	86.0	0.0	0.0	0.0	0
6B1	0.0	8.0	8.0	16.0	84.0	0.0	0.0	6.8	8.8	15.6	84.4	0.0	0.0	0.0	0
7B1	0.0	9.0	1.0	10.0	90.0	0.0	0.0	10.3	2.5	12.8	87.2	0.0	0.0	0.0	0
8B1	0.0	4.0	6.0	10.0	90.0	0.0	0.0	4.1	8.4	12.5	87.5	0.0	0.0	0.0	0
9B1	0.0	21.0	2.0	23.0	77.0	0.0	0.0	24.0	2.5	26.5	73.5	0.0	0.0	0.0	0
10B1	0.0	21.0	5.0	26.0	74.0	0.0	0.0	20.3	4.8	25.1	74.9	0.0	0.0	0.0	0
11B1	0.0	1.0	5.0	6.0	94.0	0.0	0.0	1.3	4.5	5.8	94.2	0.0	0.0	0.0	0
12B1	0.0	0.0	6.0	6.0	94.0	0.0	0.0	1.5	9.0	10.5	89.5	0.0	0.0	0.0	0
13B1	0.0	10.0	4.0	14.0	86.0	0.0	0.0	10.3	5.3	15.6	84.4	0.0	0.0	0.0	0
14B1	0.0	7.0	7.0	14.0	86.0	0.0	0.0	8.3	6.5	14.8	85.2	0.0	0.0	0.0	0
15B1	0.0	2.0	17.0	19.0	81.0	0.0	0.0	5.0	16.3	21.3	78.7	0.0	0.0	0.0	0
1M1	23.0	5.0	1.0	29.0	71.0	0.0	20.0	5.8	1.6	27.4	72.6	0.0	20.0	4.8	A
2M1	15.0	17.0	2.0	34.0	66.0	0.0	16.0	13.3	3.3	32.6	67.4	0.0	15.0	5.0	D
3M1	12.0	14.0	2.0	28.0	72.0	0.0	11.8	9.8	3.4	25.0	75.0	0.0	14.5	4.0	A
4M1	26.0	18.0	3.0	47.0	53.0	0.0	27.0	17.3	1.8	46.1	53.9	0.0	23.5	6.0	C
5M1	11.0	16.0	3.0	30.0	70.0	0.0	13.3	11.3	4.3	28.9	71.1	0.0	13.5	4.0	C
6M1	14.0	19.0	2.0	35.0	65.0	0.0	16.5	13.5	4.0	34.0	66.0	0.0	14.5	5.5	B
7M1	17.0	11.0	1.0	29.0	71.0	0.0	20.0	12.5	3.3	35.8	64.2	0.0	15.0	4.8	C
8M1	20.0	25.0	6.0	51.0	49.0	0.0	20.8	23.7	5.3	49.8	50.2	0.0	18.0	6.0	B
9M1	10.0	12.0	3.0	25.0	75.0	0.0	10.5	13.0	4.3	27.8	72.2	0.0	11.5	5.0	C
10M1	10.0	8.0	2.0	20.0	80.0	0.0	11.4	8.5	5.5	25.4	74.6	0.0	14.0	4.0	C
11M1	16.0	6.0	4.0	26.0	74.0	0.0	15.8	6.5	4.0	26.3	73.7	0.0	16.0	4.0	B
12M1	12.0	7.0	7.0	26.0	74.0	0.0	13.0	11.0	8.5	32.5	67.5	0.0	13.0	5.5	C
13M1	14.0	8.0	3.0	25.0	75.0	0.0	15.5	8.5	3.0	27.0	73.0	0.0	13.0	3.0	B
14M1	21.0	15.0	1.0	37.0	63.0	0.0	24.0	14.5	4.0	42.5	57.5	0.0	18.0	4.8	A
15M1	12.0	13.0	6.0	31.0	69.0	0.0	15.3	12.0	6.3	33.6	66.4	0.0	14.5	5.7	B

Table B.2. Continued.

ID	VEGP	TLITP	ROCKP	TCOVP	TBARP	DISP	VEGC	TLITC	ROCKC	TCOVC	TBARC	DISC	DIA	HEI
1N1	12.0	17.0	6.0	35.0	65.0	0.0	13.0	10.9	2.4	26.3	73.9	0.0	14.5	7.0
2N1	9.0	10.0	0.0	19.0	81.0	0.0	10.0	7.3	2.3	19.6	80.4	0.0	12.8	5.0
3N1	16.0	8.0	2.0	26.0	74.0	0.0	16.6	8.3	2.8	27.7	72.3	0.0	16.0	4.5
4N1	22.0	22.0	5.0	49.0	51.0	0.0	25.0	19.5	5.5	50.0	50.0	0.0	22.0	8.0
5N1	15.0	14.0	3.0	32.0	68.0	0.0	14.4	13.8	3.4	31.6	68.4	0.0	14.8	4.5
6N1	14.0	12.0	8.0	34.0	66.0	0.0	13.8	10.5	9.3	33.6	66.4	0.0	16.0	5.0
7N1	34.0	6.0	1.0	41.0	59.0	0.0	38.8	7.5	1.0	47.3	52.7	0.0	23.9	7.4
8N1	27.0	11.0	0.0	38.0	62.0	0.0	27.5	11.0	3.8	42.3	57.7	0.0	22.5	8.0
9N1	10.0	6.0	3.0	19.0	81.0	0.0	9.0	10.0	3.5	22.5	79.5	0.0	10.5	5.5
10N1	13.0	14.0	3.0	30.0	70.0	0.0	13.3	12.5	4.3	30.1	68.9	0.0	15.8	4.3
11N1	20.0	2.0	2.0	24.0	76.0	0.0	18.3	3.0	4.0	25.3	74.7	0.0	16.5	6.0
12N1	18.0	12.0	7.0	37.0	63.0	0.0	22.0	12.8	8.3	43.1	56.9	0.0	16.0	7.0
13N1	16.0	11.0	2.0	29.0	71.0	0.0	17.8	13.8	5.3	36.9	63.1	0.0	14.0	7.0
14N1	28.0	9.0	3.0	40.0	60.0	0.0	32.3	7.8	4.0	44.1	55.9	0.0	19.5	8.0
15N1	23.0	26.0	2.0	51.0	49.0	0.0	22.8	27.8	4.3	54.9	45.1	0.0	18.0	8.5
1B2	0.0	7.0	8.0	15.0	85.0	9.0	0.0	6.5	8.8	15.3	84.7	10.4	0.0	0.0
2B2	0.0	9.0	1.0	10.0	90.0	12.0	0.0	7.3	3.6	10.9	89.1	11.3	0.0	0.0
3B2	0.0	15.0	2.0	17.0	83.0	14.0	0.0	17.6	1.6	19.2	80.8	14.6	0.0	0.0
4B2	0.0	5.0	6.0	11.0	89.0	7.0	0.0	6.0	6.4	12.4	87.6	5.6	0.0	0.0
5B2	0.0	1.0	2.0	3.0	97.0	9.0	0.0	1.8	3.9	5.7	94.3	10.0	0.0	0.0
6B2	0.0	1.0	4.0	5.0	95.0	12.0	0.0	2.8	4.6	7.4	92.6	8.3	0.0	0.0
7B2	0.0	1.0	2.0	3.0	97.0	12.0	0.0	1.3	4.5	5.8	94.2	10.8	0.0	0.0
8B2	0.0	3.0	2.0	5.0	95.0	7.0	0.0	4.5	2.5	7.0	93.0	7.5	0.0	0.0
9B2	0.0	4.0	1.0	5.0	95.0	9.0	0.0	6.0	1.8	7.8	92.2	7.8	0.0	0.0
10B2	0.0	5.0	1.0	6.0	94.0	6.0	0.0	6.5	2.5	9.0	91.0	6.6	0.0	0.0
11B2	0.0	6.0	8.0	14.0	86.0	6.0	0.0	3.8	11.3	15.1	84.9	5.1	0.0	0.0
12B2	0.0	13.0	4.0	17.0	83.0	11.0	0.0	11.0	4.5	15.5	84.5	10.5	0.0	0.0
13B2	0.0	0.0	3.0	3.0	97.0	8.0	0.0	0.5	3.3	3.8	96.2	9.3	0.0	0.0
14B2	0.0	8.0	1.0	9.0	91.0	3.0	0.0	8.0	4.8	12.8	87.2	3.8	0.0	0.0
15B2	0.0	4.0	2.0	6.0	94.0	5.0	0.0	3.8	3.0	6.8	93.2	5.3	0.0	0.0
1M2	13.0	8.0	2.0	23.0	77.0	8.0	13.0	9.8	4.0	26.8	73.2	9.9	13.0	3.5
2M2	8.0	6.0	3.0	17.0	83.0	13.0	6.3	6.8	4.0	17.1	82.9	12.3	9.0	3.0
3M2	13.0	9.0	6.0	28.0	72.0	7.0	11.3	10.0	6.5	27.8	72.2	7.3	12.0	4.0
4M2	17.0	11.0	1.0	29.0	71.0	8.0	17.1	14.9	3.5	35.5	64.5	9.9	15.0	5.0
5M2	15.0	4.0	7.0	26.0	74.0	10.0	16.4	7.3	3.8	27.5	72.5	10.0	13.5	4.8
6M2	22.0	15.0	4.0	41.0	59.0	5.0	22.3	17.6	2.0	41.9	58.1	5.3	18.0	5.0
7M2	16.0	14.0	2.0	32.0	68.0	3.0	16.9	14.0	2.5	33.4	66.6	3.5	15.5	5.0
8M2	11.0	14.0	0.0	25.0	75.0	4.0	10.8	15.3	4.8	30.9	69.1	4.4	12.5	4.0
9M2	7.0	4.0	1.0	12.0	88.0	5.0	8.6	4.5	3.8	16.9	83.1	4.8	9.5	4.0
10M2	13.0	6.0	4.0	23.0	77.0	5.0	14.3	6.5	2.8	23.6	76.4	4.0	15.0	4.0
11M2	18.0	9.0	4.0	31.0	69.0	5.0	20.8	8.5	5.0	34.3	65.7	4.3	18.5	4.8
12M2	12.0	7.0	6.0	25.0	75.0	5.0	10.6	8.3	4.8	23.7	76.3	7.8	12.5	4.0
13M2	16.0	3.0	2.0	21.0	79.0	4.0	15.9	3.3	2.5	21.7	78.3	5.8	13.5	4.5
14M2	10.0	11.0	3.0	24.0	76.0	10.0	9.6	10.9	5.0	25.5	74.5	8.6	12.5	3.8
15M2	11.0	9.0	5.0	25.0	75.0	15.0	14.0	11.8	6.5	32.3	67.7	15.8	13.0	6.0
1N2	15.0	10.0	1.0	26.0	74.0	11.0	14.8	10.3	4.1	29.2	70.8	11.1	14.0	5.0
2N2	11.0	13.0	4.0	28.0	72.0	6.0	13.6	13.9	4.6	32.1	67.9	4.3	13.5	6.0
3N2	9.0	6.0	3.0	18.0	82.0	8.0	8.9	4.5	2.5	15.9	84.1	8.1	11.0	4.8
4N2	10.0	7.0	1.0	18.0	82.0	5.0	14.1	8.8	3.0	25.9	74.1	7.3	14.0	5.8
5N2	22.0	11.0	2.0	35.0	65.0	6.0	24.0	12.6	2.1	38.7	61.3	5.8	20.5	7.8
6N2	25.0	25.0	5.0	55.0	45.0	13.0	29.0	27.0	2.0	58.0	42.0	11.6	27.0	10.0
7N2	24.0	9.0	3.0	36.0	64.0	6.0	22.1	12.0	4.5	38.6	61.4	5.3	18.0	8.0
8N2	8.0	6.0	4.0	18.0	82.0	4.0	9.3	8.3	4.0	21.6	78.4	4.5	13.5	4.0
9N2	33.0	23.0	0.0	56.0	44.0	8.0	35.8	21.3	0.9	58.0	42.0	7.8	31.0	10.0
10N2	15.0	8.0	1.0	24.0	76.0	4.0	16.0	9.3	2.8	28.1	71.9	4.3	14.0	6.0
11N2	17.0	10.0	4.0	31.0	69.0	13.0	17.5	8.3	3.0	28.8	71.2	14.6	17.0	6.0
12N2	9.0	7.0	5.0	21.0	79.0	8.0	9.8	8.8	6.3	24.9	75.1	9.8	11.0	4.5
13N2	13.0	7.0	3.0	23.0	77.0	11.0	12.5	6.8	2.8	22.1	79.9	10.3	14.0	5.5
14N2	16.0	17.0	0.0	33.0	67.0	12.0	20.8	17.5	2.0	40.3	59.7	11.6	18.0	7.5
15N2	27.0	14.0	0.0	41.0	59.0	7.0	35.8	16.6	3.3	55.7	44.3	11.1	26.0	8.0

Table B.2. Continued.

ID	VEGP	TLITP	ROCKP	TCOVP	TBARP	DISP	VEGC	TLITC	ROCKC	TCOVC	TBARC	DISC	DIA	HEI	MOU
B13	0.0	2.0	1.0	3.0	97.0	43.0	0.0	5.8	3.3	9.1	90.9	47.0	0.0	0.0	0
2B3	0.0	4.0	4.0	8.0	92.0	37.0	0.0	3.5	2.9	6.4	93.6	41.5	0.0	0.0	0
3B3	0.0	3.0	0.0	3.0	97.0	38.0	0.0	4.8	2.1	6.9	93.1	37.1	0.0	0.0	0
4B3	0.0	3.0	0.0	3.0	97.0	47.0	0.0	4.8	2.3	7.1	92.9	47.8	0.0	0.0	0
5B3	0.0	7.0	1.0	8.0	92.0	35.0	0.0	7.8	4.5	12.3	87.7	33.8	0.0	0.0	0
6B3	0.0	2.0	5.0	7.0	93.0	33.0	0.0	3.8	2.5	6.3	93.7	34.6	0.0	0.0	0
7B3	0.0	2.0	1.0	3.0	97.0	36.0	0.0	2.5	3.0	5.5	94.5	38.8	0.0	0.0	0
8B3	0.0	1.0	0.0	1.0	99.0	39.0	0.0	2.3	1.8	4.1	95.9	41.8	0.0	0.0	0
9B3	0.0	8.0	1.0	9.0	91.0	30.0	0.0	7.3	2.0	9.3	90.7	29.5	0.0	0.0	0
10B3	0.0	5.0	2.0	7.0	93.0	39.0	0.0	3.8	4.0	7.8	92.2	43.0	0.0	0.0	0
11B3	0.0	4.0	6.0	10.0	90.0	36.0	0.0	5.5	5.5	11.0	89.0	37.6	0.0	0.0	0
12B3	0.0	2.0	2.0	4.0	96.0	28.0	0.0	2.5	3.0	5.5	94.5	30.0	0.0	0.0	0
13B3	0.0	2.0	3.0	5.0	95.0	45.0	0.0	4.3	5.0	9.3	90.7	50.3	0.0	0.0	0
14B3	0.0	7.0	6.0	13.0	87.0	33.0	0.0	5.8	10.8	16.6	83.4	35.0	0.0	0.0	0
15B3	0.0	1.0	2.0	3.0	97.0	34.0	0.0	1.6	3.1	4.7	95.3	34.8	0.0	0.0	0
1M3	7.0	8.0	1.0	16.0	84.0	44.0	7.7	8.3	2.8	18.8	81.2	43.8	9.0	3.5	A
2M3	7.0	11.0	9.0	27.0	73.0	29.0	8.3	10.6	6.5	25.4	74.6	32.8	11.0	4.0	A
3M3	28.0	33.0	3.0	64.0	36.0	36.0	27.3	33.8	3.3	64.4	41.0	41.0	20.5	6.0	B
4M3	11.0	11.0	1.0	23.0	77.0	39.0	11.5	10.5	6.0	28.0	72.0	30.6	11.5	4.5	A
5M3	15.0	13.0	2.0	30.0	70.0	41.0	17.8	17.6	2.0	37.4	62.6	41.1	16.5	4.0	D
6M3	15.0	9.0	0.0	24.0	76.0	34.0	16.6	8.8	1.3	26.7	73.3	33.5	13.5	4.5	A
7M3	13.0	7.0	0.0	20.0	80.0	29.0	14.9	8.0	1.5	24.4	75.6	27.8	13.0	4.5	B
8M3	6.0	11.0	0.0	17.0	83.0	30.0	8.0	11.8	1.3	21.1	78.9	30.3	11.0	4.0	A
9M3	13.0	3.0	2.0	18.0	82.0	29.0	11.1	9.1	3.3	23.5	76.5	28.0	12.0	5.0	A
10M3	22.0	17.0	0.0	39.0	61.0	24.0	22.6	18.8	2.8	44.2	55.8	26.5	18.1	4.6	B
11M3	9.0	10.0	2.0	21.0	79.0	18.0	10.3	9.6	3.8	23.7	72.3	20.1	13.0	4.0	A
12M3	21.0	11.0	2.0	34.0	66.0	30.0	17.8	10.8	2.5	31.1	68.9	29.8	15.8	4.9	B
13M3	18.0	14.0	0.0	32.0	68.0	25.0	23.8	16.6	2.8	43.2	56.8	26.3	16.5	4.3	B
14M3	11.0	10.0	5.0	26.0	74.0	38.0	10.8	9.5	8.5	28.8	71.2	38.6	13.5	4.5	C
15M3	7.0	4.0	3.0	14.0	86.0	20.0	9.8	5.3	3.3	18.4	81.6	20.8	11.5	3.5	A
1N3	15.0	9.0	7.0	31.0	69.0	30.0	14.1	9.8	8.3	32.2	67.8	31.0	13.5	6.0	D
2N3	15.0	10.0	0.0	25.0	75.0	31.0	16.9	14.3	4.8	36.0	64.0	32.5	15.6	5.9	B
3N3	25.0	21.0	4.0	50.0	50.0	46.0	27.0	15.6	2.0	44.6	55.4	45.6	19.5	7.0	E
4N3	9.0	17.0	5.0	31.0	69.0	24.0	13.3	15.6	4.3	33.2	66.8	22.8	19.0	6.0	D
5N3	12.0	11.0	0.0	23.0	77.0	30.0	14.4	15.1	1.3	30.8	69.2	33.0	14.0	6.5	D
6N3	17.0	16.0	1.0	34.0	66.0	32.0	19.3	19.8	2.8	41.9	58.1	33.3	16.5	8.0	D
7N3	12.0	11.0	1.0	24.0	76.0	38.0	15.6	12.5	1.3	29.4	70.6	41.3	14.0	6.0	C
8N3	16.0	15.0	1.0	32.0	68.0	25.0	18.3	14.3	2.5	35.1	64.9	26.8	15.5	6.0	C
9N3	10.0	6.0	6.0	22.0	78.0	35.0	9.0	9.0	6.3	24.3	75.7	39.0	11.0	7.0	D
10N3	22.0	44.0	0.0	66.0	34.0	23.0	25.0	39.0	0.8	64.8	35.2	20.8	21.0	7.0	D
11N3	9.0	9.0	3.0	21.0	79.0	23.0	11.8	10.8	4.8	27.4	72.6	27.1	12.0	5.0	C
12N3	10.0	3.0	1.0	14.0	86.0	47.0	11.5	4.0	2.8	18.3	81.7	47.0	12.0	7.0	D
13N3	12.0	12.0	3.0	27.0	73.0	35.0	16.3	16.3	5.3	37.9	62.1	39.8	14.9	5.4	C
14N3	15.0	7.0	1.0	23.0	77.0	26.0	17.3	8.5	5.0	30.8	69.2	27.5	15.5	5.0	B
15N3	8.0	4.0	1.0	13.0	87.0	36.0	9.5	6.8	4.5	20.8	79.2	40.6	12.0	6.0	B
1B4	0.0	3.0	4.0	7.0	93.0	69.0	0.0	4.8	4.5	9.3	90.7	70.8	0.0	0.0	0
2B4	0.0	0.0	3.0	3.0	97.0	58.0	0.0	1.3	4.0	5.3	94.7	61.1	0.0	0.0	0
3B4	0.0	2.0	8.0	10.0	90.0	58.0	0.0	2.8	9.5	12.3	87.7	64.8	0.0	0.0	0
4B4	0.0	1.0	1.0	2.0	98.0	57.0	0.0	2.5	3.5	6.0	94.0	60.3	0.0	0.0	0
5B4	0.0	1.0	8.0	9.0	91.0	52.0	0.0	3.3	10.8	14.1	85.9	56.8	0.0	0.0	0
6B4	0.0	1.0	2.0	3.0	97.0	65.0	0.0	2.8	4.4	7.2	92.8	68.8	0.0	0.0	0
7B4	0.0	1.0	1.0	2.0	98.0	64.0	0.0	3.0	4.5	7.5	92.5	66.4	0.0	0.0	0
8B4	0.0	1.0	5.0	6.0	94.0	72.0	0.0	2.5	2.3	4.8	95.2	73.1	0.0	0.0	0
9B4	0.0	3.0	0.0	3.0	97.0	57.0	0.0	2.8	1.5	4.3	95.7	59.3	0.0	0.0	0
10B4	0.0	2.0	6.0	8.0	92.0	64.0	0.0	2.0	4.3	6.3	93.7	67.8	0.0	0.0	0
11B4	0.0	1.0	1.0	2.0	98.0	68.0	0.0	1.8	1.8	3.6	96.4	69.8	0.0	0.0	0
12B4	0.0	3.0	1.0	4.0	96.0	55.0	0.0	1.8	3.5	5.3	94.7	55.8	0.0	0.0	0
13B4	0.0	0.0	2.0	2.0	98.0	56.0	0.0	3.5	2.5	6.0	94.0	59.8	0.0	0.0	0
14B4	0.0	2.0	1.0	3.0	97.0	54.0	0.0	3.5	4.3	7.8	92.2	56.0	0.0	0.0	0
15B4	0.0	3.0	4.0	7.0	93.0	59.0	0.0	5.8	6.5	12.3	87.7	62.3	0.0	0.0	0

Table B.2. Continued.

ID	VEGP	TLITP	ROCKP	TCOVP	TBARP	DISP	VEGC	TLITC	ROCKC	TCOVC	TBARC	DISC	DIA	HEI	MOU
1M4	15.0	22.0	1.0	38.0	62.0	58.0	15.4	17.6	1.4	34.4	65.6	63.0	13.5	3.5	B
2M4	5.0	8.0	1.0	14.0	86.0	59.0	5.0	10.4	2.5	17.9	82.1	63.1	8.3	4.0	A
3M4	8.0	2.0	2.0	12.0	88.0	58.0	8.6	5.2	2.5	16.3	83.7	62.0	12.0	3.0	A
4M4	7.0	8.0	2.0	17.0	83.0	60.0	9.6	8.1	4.0	21.7	78.3	62.3	12.5	3.0	A
5M4	5.0	10.0	3.0	18.0	82.0	50.0	9.1	14.5	2.5	26.1	73.9	53.0	11.3	3.0	B
6M4	4.0	6.0	7.0	17.0	83.0	48.0	5.6	10.6	9.8	26.0	74.0	49.8	8.5	3.5	B
7M4	13.0	10.0	0.0	23.0	78.0	78.0	12.1	12.0	1.3	25.4	79.5	79.5	14.0	3.8	A
8M4	4.0	7.0	2.0	13.0	87.0	61.0	4.0	5.8	3.0	12.8	79.2	65.8	8.5	3.0	C
9M4	6.0	7.0	1.0	14.0	86.0	58.0	7.7	7.8	1.3	16.8	83.2	62.1	10.6	3.7	A
10M4	27.0	15.0	0.0	42.0	58.0	57.0	27.0	20.3	1.3	48.6	58.3	58.3	24.0	8.0	E
11M4	9.0	8.0	1.0	18.0	82.0	47.0	12.1	9.8	2.3	24.2	75.8	50.3	11.5	4.5	A
12M4	19.0	11.0	3.0	33.0	67.0	41.0	19.5	8.6	4.0	32.1	67.9	46.8	18.4	4.9	A
13M4	14.0	5.0	0.0	19.0	81.0	53.0	15.6	3.3	1.8	20.7	79.3	57.3	13.0	4.0	A
14M4	11.0	1.0	0.0	12.0	88.0	81.0	10.0	4.0	3.0	17.0	83.0	81.8	11.5	4.5	A
15M4	11.0	8.0	4.0	23.0	77.0	57.0	10.6	9.1	4.5	24.2	75.8	63.8	11.5	6.0	A
1N4	26.0	10.0	0.0	36.0	64.0	49.0	31.1	10.6	2.5	44.2	55.8	49.0	20.5	9.0	E
2N4	6.0	15.0	1.0	22.0	78.0	61.0	9.1	17.5	3.3	29.9	70.1	63.6	12.5	4.5	B
3N4	18.0	7.0	0.0	25.0	75.0	54.0	19.3	7.3	1.5	28.1	71.9	55.5	14.5	6.0	C
4N4	9.0	12.0	1.0	22.0	78.0	58.0	9.3	10.6	5.3	25.2	74.8	59.6	14.0	5.0	E
5N4	14.0	21.0	0.0	35.0	65.0	57.0	17.6	22.0	1.8	41.4	58.6	58.5	16.6	6.2	E
6N4	16.0	11.0	2.0	29.0	71.0	50.0	19.3	12.3	3.8	35.4	64.6	51.8	14.0	5.5	B
7N4	7.0	13.0	1.0	21.0	79.0	56.0	9.6	11.0	1.8	22.4	77.6	63.0	14.5	5.0	C
8N4	9.0	5.0	0.0	14.0	86.0	59.0	9.5	6.3	1.5	17.3	82.7	62.8	11.5	5.0	B
9N4	10.0	2.0	0.0	12.0	88.0	47.0	8.6	5.8	3.3	17.7	82.3	53.3	11.5	4.0	A
10N4	18.0	8.0	2.0	28.0	72.0	55.0	18.6	5.3	1.3	25.2	74.8	58.8	17.5	6.0	C
11N4	9.0	15.0	0.0	24.0	76.0	52.0	11.8	16.5	1.5	29.8	70.2	56.0	15.0	7.0	C
12N4	5.0	12.0	0.0	17.0	83.0	50.0	4.5	11.1	2.5	18.1	81.9	51.5	13.0	3.0	B
13N4	13.0	4.0	2.0	19.0	81.0	66.0	13.8	7.0	3.8	24.6	75.4	68.3	16.0	5.0	A
14N4	10.0	5.0	0.0	15.0	85.0	59.0	9.6	8.0	3.8	21.4	78.6	65.8	10.5	5.0	A
15N4	14.0	12.0	2.0	28.0	72.0	44.0	15.8	12.3	4.8	32.9	67.1	47.6	16.0	6.0	B

Table B.3. Soil Moisture Data by Plot Type.

Format (I5,12F5.2)

REP #	B1	B2	B3	B4	M1	M2	M3	M4	N1	N2	N3	N4
1	20.21	16.60	18.16	17.77	18.44	17.41	18.05	20.64	15.06	17.34	19.69	18.74
2	19.53	18.19	18.91	16.80	16.52	21.30	18.87	20.20	17.87	16.97	18.62	19.60
3	18.12	17.98	18.34	18.72	16.85	17.23	17.98	19.09	17.75	17.87	15.23	16.77
4	21.77	17.45	20.42	20.22	20.12	21.12	19.09	19.61	19.06	18.09	16.28	19.35
5	17.59	19.23	18.54	19.16	20.63	17.24	17.57	19.28	17.94	17.41	17.20	18.52
6	15.57	18.14	19.10	18.48	17.34	17.17	22.02	19.81	17.04	18.40	18.54	17.99
7	17.21	17.10	18.59	19.48	17.91	16.67	16.94	18.64	15.86	14.99	19.39	18.04
8	17.08	17.23	20.14	17.93	19.21	19.22	17.38	21.58	16.06	17.52	18.53	17.33
9	19.58	19.93	18.87	19.31	16.44	18.57	19.63	18.00	19.23	16.75	17.08	19.67
10	18.50	18.19	16.59	16.30	17.85	18.85	17.03	17.74	18.48	18.32	16.61	18.34
11	18.53	16.39	16.40	18.21	14.90	14.80	14.12	18.94	18.12	18.90	15.58	16.66
12	16.25	16.20	17.23	14.33	19.18	14.83	15.84	16.37	16.42	16.67	16.52	18.54
13	17.18	17.60	17.59	17.98	18.81	18.91	19.20	20.18	18.47	17.49	16.71	17.70
14	18.50	19.63	18.11	16.88	16.77	21.00	17.79	20.23	16.88	18.93	17.31	20.53
15	16.79	18.10	19.66	17.68	18.78	20.70	19.90	17.58	18.34	18.32	17.91	18.24

Table B.4. Sediment Concentration Data.

Format (I5,15F5.0)

Replication

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B1D	8830.	8260.	5870.	8460.	13000	11700	4750.	7470.	11100	6450.	8040.	10300	7380.	8600.	8230.
B1W	6820.	5710.	3550.	7140.	8030.	11400	5710.	6200.	13400	4220.	5600.	9100.	4990.	6600.	6570.
M1D	8990.	5360.	4750.	7820.	9040.	9290.	9230.	7430.	10700	11100	4260.	7480.	10300	8070.	7340.
M1W	6710.	4310.	3850.	4750.	7320.	5980.	5660.	6160.	8150.	10400	2310.	5130.	8120.	6640.	5710.
N1D	9390.	5520.	6520.	7430.	8960.	7210.	8350.	9580.	9120.	6660.	5410.	6910.	7110.	7190.	6770.
N1W	7190.	4540.	6430.	5230.	7670.	5270.	7320.	6870.	7020.	6360.	3530.	6800.	5150.	4970.	5370.
B2D	11500	11400	10300	7510.	9580.	11300	8750.	8510.	8550.	7100.	7290.	11000	8400.	11900	11200
B2W	9850.	8890.	8130.	3890.	7130.	7990.	6810.	6280.	7810.	5300.	5050.	6130.	5630.	9550.	10700
M2D	8700.	10200	10000	6530.	11700	11900	9370.	6480.	9510.	12700	7890.	8710.	8670.	7370.	9380.
M2W	7340.	8140.	8530.	3290.	7150.	7260.	8880.	5090.	6760.	10400	9800.	7930.	7910.	4660.	6450.
N2D	8340.	12400	11600	9680.	6560.	6770.	9680.	7480.	11000	7620.	8460.	10300	7240.	5940.	8600.
N2W	5640.	10900	9720.	6000.	3440.	6480.	8420.	5010.	7940.	5860.	7440.	8930.	5740.	4010.	6770.
B3D	10200	12200	10200	11800	9210.	14500	8270.	10500	11200	10200	10100	10800	10400	11400	17400
B3W	6960.	7920.	6560.	8480.	6850.	13200	5060.	6890.	7200.	6610.	6820.	7490.	5880.	7620.	14600
M3D	11600	11100	5960.	8290.	7780.	8640.	14200	7270.	9140.	6320.	8350.	11700	8800.	11500	10400
M3W	8440.	8220.	4070.	6360.	4320.	5800.	11100	4010.	7860.	4110.	6010.	9350.	5050.	8980.	6080.
N3D	8450.	10400	8110.	7530.	9460.	9810.	9830.	7740.	14500	6730.	10100	11000	9620.	9840.	10500
N3W	6220.	6810.	6640.	6140.	6290.	6700.	8880.	6440.	13200	4240.	6290.	8540.	6630.	5920.	7650.
B4D	9750.	12000	11300	12100	10500	12800	10400	10400	11200	9650.	10400	12800	8670.	11600	12100
B4W	6450.	6620.	7410.	8580.	6560.	10600	9400.	6080.	9970.	6570.	7750.	8240.	6260.	8240.	7190.
M4D	9360.	15300	14200	11900	11800	11700	11300	11000	9320.	8390.	13600	10500	14600	12700	11500
M4W	5570.	10600	10300	8780.	8580.	9110.	7800.	8410.	5970.	6030.	9310.	7330.	7790.	10500	7360.
N4D	1630.	14600	9990.	7210.	6600.	8620.	9690.	9550.	13200	7940.	12000	9050.	12100	10100	10200
N4W	7450.	9140.	6910.	5300.	5460.	5770.	8370.	6920.	12100	6800.	8900.	8350.	8520.	6750.	7700.

Table B.5. Chemical Data.

Variable	Format	Description
ID	I5	Run type
EC	F5.0	Electric Conductivity (μmhos/cm)
pH	F5.1	pH reading
TA	F5.2	Total alkalinity as $CaCO_3$ (mg/l)
TDS	F5.3	Total dissolved solids (g/l)
F^-	F5.2	Flouride (mg/l)
Cl^-	F5.1	Chloride (mg/l)
SO_4^-	F5.1	Sulfate (mg/l)
Na	F5.2	Sodium (mg/l)
K	F5.2	Potassium (mg/l)
Ca	F5.2	Calcium (mg/l)
Mg	F5.2	Magnesium (mg/l)

ID	EC	pH	TA	TDS	F^-	Cl^-	SO_4^-	Na	K	Ca	Mg
1B1D	450.	7.8	14.30	.377	0.20	2.5	167.5	2.34	4.80	63.48	2.22
1B1W	350.	8.0	12.39	.172	0.25	6.4	85.0	1.76	1.40	52.90	0.89
1M1D	325.	8.2	18.10	.144	0.15	7.0	75.0	11.71	4.60	42.32	1.33
1M1W	340.	8.1	24.78	.179	0.20	5.5	77.5	4.10	3.00	26.45	2.67
1N1D	310.	8.7	19.00	.252	0.20	4.8	127.0	1.17	2.80	25.13	4.00
1N1W	220.	8.6	17.92	.200	0.10	1.3	80.0	4.10	1.60	21.16	2.44
1B2D	430.	7.3	13.34	.388	0.20	2.0	195.0	2.34	3.20	68.77	2.00
1B2W	448.	7.3	12.39	.317	0.15	4.5	170.0	1.76	2.00	63.48	1.78
1M2D	198.	7.9	19.06	.111	0.20	3.8	58.0	5.85	2.40	26.45	1.11
1M2W	120.	7.7	21.35	.110	0.10	1.3	30.0	11.71	1.20	13.23	1.33
1N2D	800.	7.6	17.16	.608	0.15	1.5	350.0	13.47	10.40	105.8	4.00
1N2W	445.	7.5	14.30	.231	0.20	5.0	120.0	5.27	2.00	60.84	1.56
1B3D	320.	8.5	16.01	.222	0.125	0.35	115.0	1.17	2.20	26.45	3.11
1B3W	195.	8.0	12.87	.129	0.15	1.8	62.5	0.59	1.20	21.16	2.00
1M3D	850.	7.9	15.25	.677	0.15	1.2	387.5	5.85	6.00	148.1	3.11
1M3W	725.	7.7	14.30	.597	0.10	1.4	140.0	2.93	3.40	105.8	1.78
1N3D	405.	7.7	18.11	.319	0.20	2.5	175.0	12.88	4.20	60.84	2.44
1N3W	345.	8.0	15.73	.351	0.15	1.8	220.0	2.93	2.80	29.10	3.78
1B4D	800.	7.7	14.30	.782	0.15	2.2	405.0	1.46	5.20	137.6	2.67
1B4W	670.	7.6	12.39	.482	0.125	0.45	297.0	1.17	10.40	55.55	2.67
1M4D	890.	7.9	18.50	.864	0.20	3.20	360.0	8.78	10.00	58.77	6.00
1M4W	650.	8.1	17.66	.623	0.20	2.15	250.0	7.03	9.40	60.84	4.00
1N4D	600.	8.0	21.25	.512	0.80	9.5	165.0	13.47	3.50	84.65	3.33
1N4W	330.	8.1	27.72	.296	0.20	7.4	77.0	18.15	4.80	29.10	4.44

Table B.5. Continued.

ID	EC	pH	TA	TDS	F^-	Cl^-	SO_4^-	Na	K	Ca	Mg
2B1D	365.	7.8	14.30	.258	0.10	1.5	120.0	1.17	1.90	52.90	1.33
2B1W	240.	8.1	12.87	.158	0.20	5.5	75.0	1.17	1.00	23.81	1.78
2M1D	290.	8.3	18.11	.224	0.20	4.3	105.0	9.37	4.60	23.81	3.11
2M1W	310.	7.6	17.16	.359	0.10	3.30	120.0	8.78	4.40	25.13	2.67
2N10	320.	8.5	13.72	.247	0.125	1.80	102.0	2.93	2.60	23.81	2.89
2N1W	190.	8.4	16.20	.252	0.075	0.80	70.0	1.76	2.00	15.87	1.78
2B2D	550.	7.7	15.25	.325	0.20	5.0	145.0	3.51	3.00	82.00	2.44
2B2W	435.	7.3	11.44	.311	0.15	6.5	128.0	1.17	1.70	63.48	1.78
2M2D	340.	7.6	14.30	.252	0.125	1.5	127.0	1.76	2.40	23.81	3.56
2M2W	208.	7.4	14.30	.157	0.10	0.80	67.5	1.76	1.20	19.84	1.78
2N2D	215.	8.0	20.02	.135	0.25	6.5	57.5	7.61	3.20	23.81	1.78
2N2W	145.	7.6	19.06	.080	0.15	4.8	42.5	6.44	2.00	17.19	1.11
2B3D	950.	8.3	15.44	.704	0.20	0.35	390.0	0.88	4.20	60.84	4.22
2B3W	650.	7.4	11.44	.382	0.15	2.5	205.0	0.59	1.60	97.87	1.56
2M3D	315.	8.2	18.11	.236	0.125	3.0	95.0	3.51	3.20	23.81	3.11
2M3W	270.	7.9	14.87	.242	0.10	1.1	101.0	2.05	3.20	23.81	2.89
2N3D	465.	7.9	19.54	.316	0.20	4.5	145.0	30.44	6.00	58.19	2.44
2N3W	422.	7.9	17.16	.286	0.20	5.8	135.0	23.42	4.40	50.26	1.56
2B4D	370.	8.3	14.73	.297	0.125	1.8	157.5	1.76	2.40	52.90	2.89
2B4W	250.	8.1	14.85	.175	0.20	3.8	82.5	0.88	5.80	39.68	1.56
2M4D	650.	8.2	22.34	.520	0.20	1.3	250.0	13.47	10.40	55.55	8.67
2M4W	455.	8.2	16.68	.418	0.125	1.05	140.0	4.10	2.00	42.32	4.89
2N4D	1500.	8.1	18.11	.641	0.25	10.5	345.0	12.88	8.60	158.7	5.33
2N4W	1060.	8.0	14.77	.928	0.20	1.5	525.0	5.85	4.40	158.7	2.89
3B1D	195.	8.2	18.11	.171	0.15	1.8	92.5	1.76	1.20	23.81	0.89
3B1W	165.	8.2	16.20	.163	0.10	0.50	60.0	1.76	1.40	15.87	1.11
3M1D	165.	7.7	19.54	.121	0.15	2.5	55.0	7.61	2.20	18.52	1.11
3M1W	170.	7.7	17.16	.117	0.10	1.5	48.0	2.93	2.00	15.87	1.56
3N1D	385.	7.7	15.25	.288	0.15	1.95	153.0	1.76	4.20	26.45	3.56
3N1W	310.	7.8	14.30	.333	0.10	0.80	135.0	1.76	3.20	26.45	2.22
3B2D	750.	7.6	13.34	1.283	0.20	0.45	5.0	1.17	3.60	26.45	2.67
3B2W	335.	7.2	12.39	.177	0.15	2.0	125.0	0.59	1.40	26.45	2.67
3M2D	410.	7.4	14.30	.293	0.15	3.55	157.0	4.68	3.20	26.45	2.67
3M2W	332.	7.7	14.30	.193	0.075	1.4	140.0	1.76	1.80	29.10	1.78
3N2D	95.	7.5	22.87	.056	0.20	2.5	20.0	7.61	1.60	7.94	0.89
3N2W	60.	7.5	23.83	.142	0.10	0.50	58.5	4.68	1.20	7.94	0.67
3B30	380.	7.5	14.77	.307	0.165	2.5	165.0	1.17	2.80	105.8	2.89
3B3W	600.	7.4	11.44	.498	0.125	0.25	262.0	1.76	2.80	47.61	3.11
3M3D	740.	8.3	19.06	.571	0.20	11.9	320.0	12.88	7.40	76.71	4.00
3M3W	550.	7.6	17.16	.478	0.15	1.5	255.0	14.64	5.00	55.55	3.56
3N3D	550.	8.1	22.40	.318	0.20	6.5	128.0	15.22	5.50	44.97	5.33
3N3W	440.	8.4	9.55	.385	0.125	3.5	185.0	8.78	4.20	26.45	3.78
3B40	410.	8.1	35.89	.358	0.15	1.5	205.0	29.27	9.40	47.61	3.33
3B4W	460.	9.0	14.75	.242	0.125	0.8	180.0	1.17	2.40	44.97	3.56
3M4D	1380.	8.4	14.60	1.063	0.20	1.3	465.0	2.93	6.80	76.71	4.89
3M4W	1020.	8.3	15.01	.848	0.20	0.8	445.0	3.51	8.00	74.07	4.44
3N4D	440.	8.5	18.11	.291	0.20	5.0	148.5	13.47	4.60	52.90	2.44
3N4W	330.	8.0	20.40	.286	0.175	3.4	122.5	7.03	3.70	31.74	3.56

Table B.5. Continued.

ID	EC	pH	TA	TDS	F^-	Cl^-	SO_4^-	Na	K	Ca	Mg
4B1D	650.	8.5	14.38	.514	0.225	0.50	220.0	1.17	4.00	52.90	2.00
4B1W	600.	8.6	14.92	.427	0.175	0.7	182.5	1.46	1.80	44.97	2.67
4M1D	330.	7.8	19.92	.262	0.15	6.3	125.0	8.78	5.60	39.68	3.78
4M1W	305.	8.1	17.76	.202	0.10	3.70	73.0	4.10	3.60	25.13	1.78
4N1D	205.	8.4	22.54	.112	0.125	1.4	125.0	11.71	5.20	31.74	1.78
4N1W	225.	8.5	22.19	.188	0.30	3.65	30.0	9.95	3.20	19.84	2.22
4B2D	165.	7.8	18.23	.278	0.15	0.8	170.0	4.68	4.00	23.81	1.78
4B2W	210.	7.9	16.37	.149	0.10	0.9	71.0	2.34	3.00	29.10	2.67
4M2D	320.	7.3	16.46	.239	0.30	5.0	127.0	3.51	3.60	39.68	3.56
4M2W	205.	7.3	16.74	.202	0.25	3.5	50.0	2.93	3.00	29.10	1.33
4N2D	245.	7.4	18.43	.190	0.30	3.9	65.0	5.27	4.60	26.45	2.22
4N2W	200.	7.8	16.62	.124	0.325	3.9	26.0	1.76	4.20	20.10	1.56
4B3D	1350.	7.9	28.43	1.066	1.00	9.1	455.0	22.83	7.20	84.65	4.89
4B3W	975.	7.7	26.08	0.854	0.93	9.5	310.0	19.91	4.20	84.65	3.78
4M3D	420.	7.2	17.16	.367	0.20	4.4	190.0	7.03	6.80	39.68	3.33
4M3W	390.	7.1	12.39	.240	0.20	2.1	150.0	4.10	3.60	39.68	1.78
4N3D	115.	7.4	27.64	.034	0.15	4.8	14.0	17.56	3.20	9.26	1.11
4N3W	80.	7.2	21.92	.054	0.125	3.1	15.0	7.61	2.40	5.29	0.89
4B4D	485.	8.0	15.73	.339	0.20	0.8	190.0	1.17	6.40	23.81	4.44
4B4W	550.	7.8	14.77	.405	0.125	0.85	220.0	1.76	5.20	44.97	3.78
4M4D	430.	10.0	23.45	.313	0.20	2.3	130.0	5.85	6.80	29.10	3.33
4M4W	255.	9.6	19.00	.201	0.10	1.5	92.0	2.63	2.80	31.74	1.78
4N4D	925.	7.8	16.68	.820	0.225	2.0	390.0	3.51	8.20	64.81	3.56
4N4W	760.	7.9	14.77	.600	0.125	1.4	347.0	1.76	5.40	55.55	2.67
5B1D	370.	7.7	14.65	.192	0.125	0.8	127.5	2.34	4.20	63.48	2.67
5B1W	375.	7.9	15.32	.265	0.10	1.4	105.0	1.17	3.00	34.39	2.67
5M1D	462.	8.0	16.83	.326	0.25	5.5	145.0	4.10	3.40	39.68	3.11
5M1W	365.	8.5	16.09	.242	0.10	1.3	115.0	2.93	2.20	39.68	2.22
5N1D	265.	7.9	20.09	.217	0.15	6.0	95.0	8.78	3.80	37.03	2.44
5N1W	285.	9.0	18.53	.217	0.175	2.25	52.5	5.27	3.00	25.13	2.22
5B2D	590.	7.8	14.66	.392	0.125	0.75	220.0	1.46	3.20	49.99	2.89
5B2W	550.	7.8	16.36	.402	0.075	1.6	185.0	1.76	1.60	23.81	2.67
5M2D	500.	7.4	28.15	.420	0.10	1.5	190.0	21.66	5.60	66.13	2.89
5M2W	325.	7.3	23.39	.244	0.30	5.5	105.0	12.59	3.60	29.10	2.44
5N2D	820.	7.4	21.06	.705	16.21	9.5	300.0	12.00	12.00	59.99	2.89
5N2W	720.	7.5	16.62	.612	0.325	6.9	262.5	4.39	7.00	55.55	4.00
5B3D	750.	7.5	28.20	0.598	0.93	9.5	185.0	22.25	5.20	76.71	4.89
5B3W	600.	7.4	14.19	0.505	0.80	9.5	37.0	2.34	4.20	79.36	4.22
5M3D	265.	7.7	22.87	.213	0.20	5.55	90.0	10.54	7.80	34.39	2.22
5M3W	220.	7.6	25.16	.200	0.25	5.7	50.0	8.78	5.80	15.00	1.78
5N3W	200.	7.2	21.92	.162	0.225	5.6	65.0	8.20	3.20	15.00	1.78
5N3W	170.	7.3	19.06	.177	0.125	3.35	43.0	8.20	2.80	15.00	1.33
5B4D	310.	7.9	22.87	.247	0.20	6.0	115.0	1.76	5.40	27.51	2.89
5B4W	320.	7.8	15.25	.252	0.20	5.5	120.0	1.17	3.20	58.19	2.22
5M4D	420.	9.9	18.11	.416	0.20	2.30	160.0	5.85	5.00	58.19	2.44
5M4W	350.	9.7	19.00	.249	0.125	1.2	140.0	2.93	3.40	29.10	2.67
5N4D	220.	7.9	21.92	.155	0.15	1.65	40.0	5.85	5.20	17.46	2.00
5N4W	200.	8.1	22.87	.164	0.175	1.65	42.0	4.68	4.20	12.43	1.56

Table B.5. Continued.

ID	EC	pH	TA	TDS	F^-	Cl^-	SO_4^-	Na	K	Ca	Mg
6B1D	600.	7.8	14.18	.414	0.20	1.25	240.0	1.76	3.20	67.45	1.78
6B1W	550.	8.0	14.61	.416	0.125	0.6	200.0	2.05	2.00	59.99	2.67
6M1D	250.	7.7	23.74	.212	0.20	3.5	72.5	13.47	5.60	33.06	2.00
6M1W	170.	7.8	20.86	.162	0.15	2.2	85.0	7.61	3.20	15.87	1.56
6N1D	305.	8.3	18.82	.216	0.20	3.35	50.0	5.85	3.80	26.45	2.44
6N1W	200.	8.5	18.82	.133	0.20	2.8	60.0	5.85	2.40	26.45	1.78
6B2D	240.	7.4	15.32	.222	0.25	2.65	60.0	1.17	2.20	34.39	2.00
6B2W	170.	7.5	16.36	.104	0.15	1.2	52.5	1.76	1.00	23.81	1.11
6M2D	240.	7.7	22.61	.184	0.35	9.0	27.5	10.54	4.60	20.00	2.00
6M2W	110.	7.4	14.30	.072	0.20	3.65	7.5	4.10	1.20	10.05	0.89
6N2D	292.	7.8	15.38	.330	0.15	1.20	145.0	1.76	7.00	39.68	2.89
6N2W	330.	8.1	18.08	.254	0.10	2.05	93.0	5.85	5.20	37.56	4.22
6B3D	575.	7.4	30.42	0.512	1.00	9.7	83.0	24.59	5.60	70.10	5.11
6B3W	550.	7.5	28.69	0.449	0.30	5.5	185.0	22.25	5.00	65.07	3.56
6M3D	200.	7.3	21.92	.133	0.20	3.0	65.0	3.51	4.80	21.16	1.33
6M3W	180.	7.1	21.92	.118	0.25	3.80	45.0	7.03	3.40	17.46	1.33
6N3D	600.	7.4	20.02	.384	0.225	4.2	190.0	11.12	7.40	47.61	4.22
6N3W	380.	7.2	16.58	.319	0.125	2.4	165.0	5.27	5.40	39.68	3.56
6B4D	200.	8.1	19.00	.158	0.20	1.1	65.0	1.76	4.70	20.00	1.78
6B4W	165.	7.8	14.30	.316	0.15	0.95	55.0	2.63	2.00	20.00	1.33
6M4D	230.	8.7	20.97	.098	0.25	2.8	45.0	4.10	4.00	31.74	1.67
6M4W	375.	7.9	15.06	.265	0.20	1.40	110.0	2.93	3.40	32.54	2.44
6N4D	360.	9.2	19.00	.282	0.125	3.0	145.0	5.85	6.20	37.03	2.44
6N4W	240.	8.7	16.20	.186	0.125	1.8	105.0	3.51	2.00	29.89	1.78
7B1D	195.	8.2	17.16	.202	0.125	0.70	70.0	3.51	0.40	22.48	1.78
7B1W	145.	8.3	13.34	.098	0.20	0.5	48.0	0.59	1.20	20.00	0.89
7M1D	285.	7.7	22.87	.201	0.125	2.5	105.0	4.10	4.40	29.10	1.78
7M1W	170.	7.3	13.34	.160	0.08	1.40	55.0	4.10	1.60	19.84	0.78
7N1D	225.	8.3	22.40	.172	0.25	10.5	62.5	16.98	5.40	20.00	1.56
7N1W	125.	8.5	20.97	.093	0.15	0.85	52.0	11.12	2.20	10.58	0.89
7B2D	1100.	7.4	12.39	.962	0.20	0.5	500.0	1.17	4.60	67.45	3.33
7B2W	775.	7.4	12.39	.589	0.125	0.45	355.0	1.17	1.40	67.45	2.67
7M2D	750.	7.1	14.30	.584	0.225	3.35	160.0	5.56	4.80	67.45	2.67
7M2W	800.	6.9	14.30	.604	0.20	1.75	225.0	2.93	3.80	105.8	2.00
7N2D	280.	7.0	23.83	.186	0.125	4.8	95.0	14.34	4.80	29.10	2.22
7N2W	310.	7.2	18.11	.210	0.125	3.0	120.0	12.00	5.00	29.10	2.89
7B3D	1480.	8.0	13.43	1.451	0.325	0.75	933.0	2.34	4.40	99.99	2.67
7B3W	1100.	7.7	11.64	1.056	0.17	0.35	680.0	0.59	2.40	84.65	2.22
7M3D	260.	9.1	19.69	.172	0.20	4.9	102.5	9.95	7.20	29.10	3.11
7M3W	215.	8.8	19.25	.151	0.08	0.30	7.5	7.03	4.40	22.48	2.22
7N3D	750.	8.1	15.22	.619	0.20	60.0	375.0	7.03	5.00	70.10	4.00
7N3W	830.	8.5	13.43	.752	0.125	1.95	415.0	2.93	4.40	79.36	3.11
7B4D	900.	8.0	16.11	.844	0.20	0.65	445.0	1.17	5.20	77.24	2.22
7B4W	820.	8.1	12.53	.752	0.20	0.5	445.0	1.17	2.80	67.45	1.78
7M4D	1400.	8.0	15.22	1.317	0.325	1.45	665.0	3.51	7.60	99.99	2.00
7M4W	1200.	7.8	14.32	1.050	0.25	1.8	550.0	4.10	6.80	95.23	1.78
7N4D	586.	7.4	18.56	0.426	0.00	0.00	0.00	0.00	0.40	0.00	0.00
7N4W	450.	8.6	17.01	.359	0.16	1.4	195.0	5.85	4.00	50.26	3.11

Table B.5. Continued.

ID	EC	pH	TA	TDS	F^-	Cl^-	SO_4^-	Na	K	Ca	Mg
8B1D	410.	7.6	15.44	.307	0.125	0.35	175.0	1.17	2.20	44.97	2.67
8B1W	410.	7.4	13.34	.300	0.125	0.35	165.0	0.59	2.00	44.97	1.78
8M1D	240.	7.1	17.16	.173	0.175	4.5	70.0	6.44	5.40	25.92	1.78
8M1W	165.	7.2	16.20	.088	0.15	1.75	55.0	4.68	3.60	15.08	1.11
8N1D	260.	7.4	20.02	.166	0.15	5.3	85.0	9.37	4.00	26.45	1.78
8N1W	180.	7.3	20.02	.108	0.075	1.95	50.0	6.44	2.40	18.52	1.33
8B2D	260.	6.9	15.25	.141	0.125	0.55	82.5	1.76	4.40	25.00	1.78
8B2W	165.	7.8	14.77	.121	0.10	0.65	52.2	1.17	1.90	20.10	1.11
8M2D	630.	6.8	19.06	.458	0.10	5.0	252.0	5.27	2.80	71.42	2.67
8M2W	620.	7.1	14.30	.423	0.15	1.65	250.0	2.34	2.20	55.55	1.78
8N2D	400.	7.1	12.39	.284	0.075	2.00	140.0	4.68	3.20	50.26	2.22
8N2W	320.	7.2	13.34	.255	0.125	1.1	130.0	2.34	1.60	34.39	2.22
8B3D	465.	8.5	15.22	.303	0.15	0.30	205.0	1.76	2.20	49.99	2.22
8B3W	950.	8.1	15.22	.807	0.20	0.40	415.0	1.17	5.00	74.07	2.67
8M3D	100.	8.9	21.04	.147	0.20	1.5	20.0	2.93	2.40	12.43	1.56
8M3W	82.	9.1	18.35	.061	0.075	0.50	17.5	1.17	1.60	10.00	0.89
8N3D	950.	8.2	17.46	.813	0.15	3.25	580.0	11.71	4.80	74.07	2.22
8N3W	675.	8.1	15.22	.543	0.15	1.80	325.0	3.51	3.60	65.07	2.89
8B4D	190.	9.1	20.59	.160	0.20	0.45	65.0	2.05	2.60	20.00	1.11
8B4W	160.	9.1	16.11	.108	0.10	0.65	50.0	1.17	1.00	15.00	1.11
8M4D	1350.	7.8	16.11	1.337	0.25	1.10	925.0	2.93	5.80	92.32	2.67
8M4W	1100.	8.1	12.85	.929	0.25	0.55	685.0	0.59	4.20	79.88	2.22
8N4D	235.	8.9	18.80	.171	0.16	4.2	65.0	8.20	4.40	25.00	2.22
8N4W	145.	7.1	19.69	.100	0.125	1.5	37.5	2.93	5.00	15.08	1.33
9B1D	590.	7.1	12.87	.424	0.20	0.5	285.0	2.34	4.40	57.40	2.00
9B1W	720.	6.9	13.34	.556	0.20	0.40	335.0	0.59	3.60	66.13	1.33
9M1D	390.	7.7	16.68	.283	0.125	2.6	160.0	4.68	5.40	39.94	1.89
9M1W	255.	7.8	14.30	.187	0.10	2.5	97.5	3.22	1.80	37.03	1.33
9N1D	620.	7.7	16.20	.541	0.10	3.2	305.0	7.61	4.20	89.94	2.22
9N1W	700.	7.4	12.87	.567	0.15	1.1	302.0	2.34	3.20	65.07	1.78
9B2D	550.	7.2	13.34	.248	0.125	0.6	285.0	0.59	4.00	60.05	2.22
9B2W	600.	7.2	12.39	.434	0.100	0.45	153.0	0.59	2.60	55.55	1.78
9M2D	850.	7.2	14.30	.646	0.20	2.45	335.0	5.85	8.20	72.48	2.22
9M2W	750.	7.2	12.87	.646	0.15	1.1	362.0	1.76	2.20	67.45	1.56
9N2D	390.	7.2	28.02	.287	0.20	8.3	117.0	19.91	9.40	34.92	3.33
9N2W	275.	7.8	26.69	.188	0.20	3.55	80.0	13.47	5.00	25.13	2.67
9B3D	1210.	7.4	15.67	2.913	0.225	0.30	515.0	0.59	8.40	84.65	3.33
9B3W	450.	8.8	12.98	.327	0.10	0.50	200.0	0.88	1.80	47.61	1.78
9M3D	330.	7.1	16.11	.239	0.075	5.0	108.0	7.61	5.40	34.92	2.67
9M3W	250.	8.8	16.56	.189	0.10	2.25	95.0	2.34	2.20	29.89	2.00
9N3D	1325.	7.7	13.88	1.146	0.20	3.0	800.0	1.17	4.60	89.94	2.67
9N3W	1100.	7.1	13.43	.997	0.15	1.0	575.0	1.76	4.40	84.56	2.22
9B4D	650.	8.0	12.98	.614	0.00	0.5	360.0	0.59	3.00	67.45	1.78
9B4W	710.	8.3	12.98	.547	0.14	0.70	285.0	1.17	2.20	65.07	1.33
9M4D	310.	8.6	17.90	.117	0.20	1.4	110.0	4.98	3.60	32.54	2.44
9M4W	270.	8.8	24.62	.163	0.14	1.05	95.0	1.76	2.00	29.10	1.78
9N4D	850.	8.4	16.56	.725	0.15	2.25	360.0	4.10	7.00	74.86	2.67
9N4W	900.	8.2	14.32	.748	0.20	2.50	475.0	1.46	4.20	72.48	2.22

Table B.5. Continued.

ID	EC	pH	TA	TDS	F^-	Cl^-	$SO_4^{=}$	Na	K	Ca	Mg
10B1D	310.	7.6	15.25	.216	0.125	0.8	116.0	1.46	2.20	25.00	2.44
10B1W	190.	7.5	12.53	.163	0.08	0.35	75.0	1.76	0.90	20.00	1.00
10M1D	510.	8.5	17.90	.526	0.20	4.8	190.0	12.88	5.20	44.97	3.11
10M1W	560.	8.8	17.01	.287	0.00	2.5	132.0	11.12	4.60	32.27	2.22
10N1D	575.	7.9	14.77	.441	0.20	4.50	235.0	4.68	3.80	52.37	3.33
10N1W	730.	8.1	14.77	.599	0.20	1.2	360.0	2.93	3.20	60.05	2.67
10B2D	355.	7.4	14.32	.229	0.16	0.40	160.0	1.76	1.80	39.68	2.22
10B2W	190.	7.5	17.90	.159	0.075	0.35	67.0	1.76	1.00	22.48	1.11
10M2D	900.	8.0	16.56	.705	0.16	3.5	585.0	4.68	4.80	74.07	2.67
10M2W	1050.	7.5	12.53	.939	0.08	1.30	685.0	3.51	3.60	22.48	2.22
10N2D	320.	8.5	19.69	.103	0.15	0.95	115.0	12.88	6.80	29.89	2.22
10N2W	240.	8.5	16.11	.193	0.125	3.8	75.0	5.85	6.20	25.13	1.33
10B3D	360.	8.0	17.46	.265	0.125	0.75	145.0	2.34	2.60	39.68	2.89
10B3W	380.	8.0	13.43	.576	0.10	0.35	162.5	1.17	1.80	39.68	2.22
10M3D	425.	7.2	19.69	.321	0.15	5.8	148.0	8.20	4.40	39.68	2.67
10M3W	250.	8.5	17.90	.207	0.075	3.0	87.5	5.85	2.40	26.45	1.33
10N3D	700.	7.9	22.87	.514	0.30	8.2	275.0	13.47	8.00	55.55	4.44
10N3W	340.	8.3	22.38	.553	0.20	5.20	120.0	5.27	4.00	29.89	3.11
10B4D	315.	7.7	19.06	.179	0.125	0.70	112.0	1.46	3.00	29.89	2.44
10B4W	405.	7.3	19.63	.231	0.10	0.70	1555.	1.17	2.40	39.68	2.22
10M4D	400.	8.5	24.17	.327	0.225	9.5	150.0	16.98	7.80	71.42	2.67
10M4W	300.	7.8	25.92	.160	0.10	5.8	88.0	9.95	5.60	20.00	1.78
10N4D	460.	8.4	19.69	.328	0.225	8.0	177.5	12.88	5.20	44.97	3.56
10N4W	430.	7.2	19.69	.355	0.15	4.5	172.5	7.03	4.20	42.32	3.11
11B1D	255.	8.7	14.77	.204	0.15	0.45	110.0	1.17	1.60	29.10	1.56
11B1W	290.	8.4	13.43	.239	0.10	0.25	135.0	1.17	2.40	37.03	1.78
11M1D	160.	7.6	15.22	.093	0.12	6.6	45.0	9.37	1.80	10.58	1.33
11M1W	112.	7.2	14.68	.035	0.075	1.9	30.0	2.93	1.20	10.58	1.00
11N1D	340.	8.7	17.01	.234	0.00	5.00	120.0	9.37	2.40	23.81	2.00
11N1W	220.	8.9	15.22	.146	0.14	2.0	70.0	1.17	1.80	18.52	1.33
11B2D	1100.	7.2	14.77	1.050	0.175	0.4	625.0	1.17	3.60	74.86	1.67
11B2W	860.	7.4	15.22	.567	0.125	0.5	425.0	1.46	2.40	103.2	1.56
11M2D	520.	7.6	18.80	.444	0.125	2.6	155.0	13.47	5.80	58.19	3.11
11M2W	370.	7.5	15.22	.281	0.10	3.0	160.0	3.51	2.40	39.68	1.89
11N2D	500.	8.1	16.11	.402	0.25	3.2	240.0	5.85	7.00	44.97	3.11
11N2W	410.	8.3	15.22	.271	0.12	1.5	180.0	4.68	2.60	44.97	2.22
11B3D	215.	8.1	20.97	.131	0.10	0.9	85.0	2.93	2.20	19.84	1.78
11B3W	170.	7.5	17.01	.105	0.075	0.55	50.0	1.76	1.80	15.87	1.11
11M3D	135.	8.6	22.87	.110	0.125	4.1	30.0	7.61	3.80	13.23	1.11
11M3W	95.	7.4	20.59	.037	0.075	1.9	14.5	8.78	3.80	34.39	3.00
11N3D	205.	8.3	22.30	.140	0.15	2.2	72.5	6.44	5.20	17.46	1.78
11N3W	165.	7.1	16.11	.107	0.10	1.6	50.0	5.27	3.00	13.23	1.56
11B4D	280.	8.6	19.25	.226	0.125	0.65	102.5	1.17	2.60	26.45	2.44
11B4W	575.	8.0	14.32	.472	0.125	0.40	260.0	1.17	2.80	63.48	3.56
11M4D	1120.	8.0	19.25	.761	0.25	4.75	445.0	11.12	7.00	105.8	3.78
11M4W	850.	8.0	16.56	.637	0.20	1.7	330.0	4.10	4.00	84.65	1.33
11N4D	340.	8.3	21.35	.283	0.20	2.4	140.0	5.27	5.80	37.03	3.11
11N4W	270.	8.6	17.90	.176	0.10	1.35	100.0	4.10	3.20	23.81	2.22

Table B.5. Continued.

ID	EC	pH	TA	TDS	F^-	Cl^-	SO_4^-	Na	K	Ca	Mg
12B1D	130.	7.6	13.43	.068	0.10	0.30	42.5	1.17	1.80	11.90	1.44
12B1W	155.	7.7	11.64	.108	0.175	9.0	85.0	1.17	1.00	13.23	1.11
12M1D	750.	8.1	15.82	.597	0.075	5.3	320.0	7.03	4.80	71.42	3.11
12M1W	425.	8.5	15.67	.367	0.10	2.20	205.0	4.10	2.00	47.61	1.56
12N1D	235.	8.9	19.69	.192	0.15	1.0	105.0	13.47	4.80	18.52	1.78
12N1W	292.	7.5	17.08	.234	0.08	3.6	177.0	8.20	3.40	37.03	2.89
12B2D	260.	8.4	16.11	.092	0.125	0.35	115.0	1.76	2.60	26.45	1.78
12B2W	325.	7.8	14.87	.121	0.10	0.55	90.0	1.46	0.40	23.81	1.33
12M2D	285.	7.3	16.11	.221	0.125	2.15	95.0	4.10	3.00	29.89	1.78
12M2W	210.	7.6	15.22	.031	0.10	1.25	72.0	2.93	1.60	15.87	1.11
12N2D	225.	8.2	20.97	.124	0.125	2.4	70.0	4.10	3.80	15.08	1.78
12N2W	150.	8.5	17.90	.083	0.25	1.6	37.5	3.51	1.80	11.90	1.56
12B3D	160.	8.5	17.01	.126	0.10	0.50	50.0	1.17	1.20	13.23	1.78
12B3W	105.	8.8	17.01	.080	0.25	1.25	20.0	1.46	0.90	5.29	0.89
12M30	775.	7.8	19.25	.565	0.15	6.0	365.0	16.98	8.00	74.07	4.00
12M3W	650.	7.9	13.53	.512	0.10	3.3	285.0	12.30	6.40	58.19	2.67
12N30	450.	8.4	18.35	.338	0.20	4.50	185.0	7.61	4.40	38.36	2.89
12N3W	375.	7.9	17.01	.235	0.15	4.0	120.0	4.68	3.00	37.03	2.22
12B4D	355.	8.4	17.35	.253	0.125	2.05	130.0	7.03	4.40	29.10	2.89
12B4W	750.	7.0	14.32	.579	0.125	2.8	347.5	11.12	7.60	68.77	4.22
12M4D	680.	7.3	21.54	.475	0.125	3.9	275.0	4.10	9.00	55.55	3.33
12M4W	625.	8.2	19.25	.418	0.17	9.5	225.0	4.39	4.60	52.90	2.67
12N4D	900.	7.6	20.02	.792	0.285	1.7	425.0	12.88	4.20	97.87	3.78
12N4W	900.	7.4	17.16	.677	0.125	1.6	340.0	2.93	4.80	84.65	2.67
13B1D	255.	8.3	17.01	.194	0.10	0.7	98.0	1.76	1.60	37.03	2.11
13B1W	128.	8.6	16.58	.080	0.125	0.70	37.0	2.05	1.40	13.23	0.89
13M1D	760.	7.9	16.39	.588	0.150	2.65	320.0	4.68	4.80	87.29	2.89
13M1W	750.	7.6	16.39	.526	0.15	1.30	285.0	2.93	4.20	79.36	2.00
13N1D	485.	8.5	17.01	.516	0.20	4.75	220.0	7.61	5.20	52.90	3.33
13N1W	435.	8.3	14.32	.336	0.80	1.2	190.0	2.34	2.00	52.90	1.78
13B2D	850.	7.2	14.30	.603	0.125	0.85	360.0	1.76	5.40	92.58	3.56
13B2W	800.	7.5	13.34	.564	0.10	0.55	320.0	1.46	2.80	89.94	2.44
13M2D	750.	7.4	17.16	.507	0.20	4.7	297.0	8.78	4.60	82.00	2.67
13M2W	750.	7.2	15.44	.590	0.125	2.25	285.0	4.10	3.80	79.36	2.00
13N2D	675.	7.0	14.32	.562	0.20	4.9	307.5	5.85	3.80	76.71	3.11
13N2W	485.	7.5	15.25	.334	0.125	2.05	180.0	3.51	2.60	42.32	2.44
13B3D	330.	8.4	16.11	.244	0.15	0.90	142.0	2.93	2.80	31.74	3.33
13B3W	205.	8.7	14.32	.185	0.12	0.50	77.5	2.05	1.40	18.52	1.78
13M3D	350.	8.1	17.90	.290	0.20	5.5	120.0	10.54	5.80	52.90	3.33
13M3W	190.	9.0	16.11	.099	0.08	3.6	60.0	4.10	3.20	21.16	0.89
13N3D	300.	7.4	23.83	.169	0.20	7.3	95.0	11.12	4.80	26.45	2.22
13N3W	190.	8.9	21.04	.158	0.08	3.4	52.5	4.98	2.40	18.52	1.33
13B4D	325.	7.5	16.39	.342	0.125	2.05	130.0	2.34	3.80	37.03	0.89
13B4W	230.	7.2	13.43	.142	0.10	0.35	72.0	1.76	1.80	21.16	1.56
13M4D	1150.	7.8	15.67	1.105	0.25	5.0	585.0	8.78	5.60	132.3	6.00
13M4W	775.	7.4	14.87	.680	0.125	2.8	320.0	4.68	4.00	84.65	2.89
13N4D	560.	8.4	16.11	.306	0.15	2.5	250.0	3.51	4.00	68.77	3.56
13N4W	450.	8.4	15.67	.332	0.14	1.4	175.0	4.98	2.60	39.68	2.67

Table B.5. Continued.

ID	EC	pH	TA	TDS	F^-	Cl^-	$SO_4^=$	Na	K	Ca	Mg
14B1D	240.	7.5	16.20	.123	0.10	0.45	83.5	2.34	2.40	23.81	1.11
14B1W	180.	8.6	18.11	.188	0.15	0.65	0.12	0.59	2.20	21.16	0.89
14M1D	320.	8.2	20.02	.193	0.15	11.9	110.0	13.47	3.60	31.74	1.78
14M1W	470.	7.8	11.63	.290	0.075	2.7	265.0	5.27	3.40	68.77	2.67
14N1D	330.	8.2	20.59	.255	0.20	23.0	97.0	10.54	4.20	26.45	1.78
14N1W	155.	7.3	18.50	.061	0.15	0.65	38.0	9.37	2.60	11.90	0.89
14B2D	145.	7.3	20.21	.058	0.125	0.75	34.0	2.34	4.00	13.23	1.11
14B2W	135.	8.4	20.59	.091	0.075	0.55	35.0	1.76	2.60	13.23	0.89
14M2D	410.	7.5	17.54	.233	0.125	2.85	155.0	4.10	4.00	42.32	2.67
14M2W	310.	7.3	14.87	.163	0.75	1.2	110.0	2.34	2.40	31.74	1.78
14N2D	280.	8.4	13.43	.199	0.80	5.7	95.0	7.03	3.60	23.81	1.78
14N2W	250.	7.4	20.02	.126	0.20	3.8	80.0	5.27	3.00	50.26	1.22
14B3D	629.	7.6	16.07	0.692	0.125	0.45	100.0	2.34	1.40	29.10	1.44
14B3W	220.	8.7	17.90	.166	0.14	0.65	85.0	1.76	1.20	23.81	0.89
14M3D	215.	7.3	21.92	.091	0.15	3.6	62.0	5.85	4.00	18.52	1.78
14M3W	220.	8.7	19.69	.207	0.10	1.35	85.0	1.76	2.80	26.45	1.33
14N3D	230.	8.6	18.35	.148	0.15	7.00	62.0	2.34	3.60	18.52	1.56
14N3W	145.	8.8	20.59	.094	0.08	2.8	42.5	4.68	2.20	13.23	1.11
14B4D	600.	8.0	17.90	.541	0.125	0.4	295.0	1.17	4.40	74.07	3.11
14B4W	440.	7.2	13.43	.300	0.125	0.5	180.0	1.17	1.40	50.26	1.78
14M4D	1000.	8.2	16.11	.801	0.285	1.85	415.0	6.44	7.80	105.8	3.78
14M4W	850.	8.2	14.32	.869	0.225	1.85	416.6	4.10	4.20	105.8	2.44
14N4D	390.	7.3	16.56	.271	0.125	1.35	150.0	4.98	5.40	42.32	2.44
14N4W	220.	8.4	16.77	.160	0.15	0.70	82.5	4.68	2.80	39.68	1.78
15B1D	155.	8.7	16.56	.181	0.10	0.65	50.0	1.76	2.20	18.52	1.33
15B1W	420.	8.2	14.32	.303	0.285	1.7	177.5	2.93	3.40	58.19	2.44
15M1D	360.	8.1	18.59	.244	0.075	7.4	145.0	7.03	4.20	39.68	2.00
15M1W	300.	8.3	17.01	.256	0.20	2.8	125.0	1.76	2.00	42.32	1.11
15N1D	210.	8.7	25.51	.161	0.18	9.5	45.0	12.88	5.20	17.19	1.78
15N1W	110.	8.8	22.83	.042	0.20	4.5	0.25	6.44	4.00	13.23	0.89
15B2D	220.	8.8	20.14	.161	0.15	1.85	75.0	11.71	4.00	21.16	1.33
15B2W	170.	7.4	19.00	.060	0.10	2.05	45.0	8.78	1.40	15.87	0.89
15M2D	340.	8.5	18.35	.238	0.08	5.00	120.0	3.51	3.60	37.03	1.33
15M2W	255.	8.8	15.67	.196	0.20	2.40	84.0	4.68	2.60	29.10	1.11
15N2D	205.	8.2	30.64	.112	0.25	15.2	102.0	21.66	9.20	29.10	2.44
15N2W	190.	8.8	22.38	.065	0.20	3.85	47.5	12.30	3.60	18.52	1.33
15B3D	1050.	7.9	14.68	.946	0.225	0.6	425.0	1.17	4.40	127.0	4.44
15B3W	1275.	7.4	14.30	.933	0.20	0.6	445.0	1.76	2.20	171.9	3.33
15M3D	500.	8.4	17.01	.373	0.20	2.05	190.0	5.85	5.60	55.55	3.11
15M3W	410.	8.4	16.11	.283	0.15	1.4	165.0	4.39	2.20	52.90	1.78
15N3D	445.	8.2	19.69	.368	0.20	6.1	185.0	4.39	1.40	50.26	2.67
15N3W	315.	7.1	18.01	.273	0.125	3.35	57.0	6.44	4.20	34.39	1.56
15B4D	135.	7.4	20.14	.088	0.20	0.75	35.0	3.51	3.60	14.55	1.11
15B4W	75.	7.5	18.80	.046	0.10	0.55	100.5	2.34	0.80	6.61	0.67
15M4D	395.	8.2	18.80	.381	0.20	6.0	162.5	9.95	7.40	52.90	2.44
15M4W	375.	7.2	17.90	.289	0.10	6.0	155.0	2.34	3.00	50.26	1.33
15N4D	425.	8.3	18.35	.391	0.21	9.15	145.0	2.93	5.00	50.26	2.00
15N4W	320.	8.5	16.56	.176	0.10	2.15	135.0	5.85	3.60	50.26	1.78

Table B.6. Woodside Trampling Study Site - Soil Variability Study Results.*

Sample Description		pH	EC	Ca**	Mg**	Na**	SAR
# 1	0-2cm	7.75	1.16	321.7	15.3	9.0	0.13
# 1	2-6cm	7.85	2.25	625.0	44.3	27.0	0.28
# 2	0-2cm	7.75	2.25	650.0	41.5	31.3	0.32
# 3	0.2cm	7.85	2.18	635.0	35.7	38.0	0.40
# 4	0-2cm	7.78	2.40	648.3	56.0	28.0	0.28
# 5	0-2cm	7.88	2.32	616.7	34.3	27.0	0.29
# 6	0-2cm	7.83	2.28	615.0	36.7	35.7	0.38
# 6	2-6cm	7.74	2.70	576.7	118.0	62.6	0.62
# 7	0-2cm	7.81	2.88	606.5	43.7	111.0	1.17
# 8		7.85	2.22	603.3	28.0	23.0	0.25
# 9	0-2cm	7.81	2.27	611.7	31.3	50.0	0.53
#10	0-2cm	7.89	2.40	581.4	36.7	84.3	0.92
#11		7.77	1.85	511.7	30.4	18.2	0.21
#12		7.90	2.82	668.3	57.3	133.3	1.33
#13		7.81	2.32	648.3	33.3	33.2	0.34
#14	0-2cm	7.86	2.24	630.0	35.6	23.1	0.24
#15	0-2cm	8.23	11.00	276.7	161.7	2336	27.60
#16	0-2cm	8.31	12.30	258.3	201.6	2443	27.68
#17	0-2cm	8.43	8.13	81.7	110.0	1833	31.13
#18	0-2cm	8.42	11.74	248.3	111.8	2430	32.17

**Values in mg/L of saturation extract.

*Analytical work performed by the Reclamation Research Laboratory, Montana State University, Bozeman, MT, under the direction of Dr. Frank Munshower.

Table B.7. Woodside Trampling Study Site - Soil Variability Study, Profile Descriptions*

Soil sampling on the Simons, Li, and Associates Trampling Study Site to determine spatial variability in the soil resource.

Notes from the profiles sampled for analysis.

Sample No.	Depth(s)	Notes
1	0-2 cm 2-6 cm	Located in the southwest corner of the second plot west of the dozer trail. Some cementation or weak blocky structure at 1.5 to 2 cm; definite particles present at depths greater than 6 cm; some strate have white salt encrustrations within the shale materials; fine shale particles up to 1.5 cm in diameter and 1 mm in thickness occur at 12-15 cm; polygonal surface platelets that are of pedogenic origin are 6-10 by 10-15 cm in diameter and average about 0.5 cm in thickness.
2	0-2 cm	Thickness in the surface crusts ranges from 0.4 to 0.8 cm and are polygonal in character; platelets are 3-6 by 6-12 cm in diameter; very fine shale particles 1-3 mm in diameter lie just below the surface polygonal structure.
3	0-2 cm	Atriplex nuttalli which is 20-35 cm in diameter lies upslope; 2-5 mm diameter shale platelets occur at 2 cm in depth; there is some gradation in size from the surface downward in the identifiable shale platelets; 0.8-1.2 cm thick polygons or surface plates which are 4-7 x 8-14 cm in diameter; Eriogonom inflatum on or near the sampling site.
4	0-2 cm	Eriogonum inflatum in the plot; 1-3 mm diameter shale platelets at 2 cm; polygonar structural on the surface are 0.6-1 cm in thickness and 4-8 x 8-15 cm in diameter; few salt precipitates in the shale platelets are found deeper in the regolith.
5	0-2 cm	More apparent physical weathering at this site; 1-2 mm platelet diameter at 2 cm in depth; polygonar surface plates are 5-8 mm thick; and 5-8 x 6-12 cm in diameter; Eriogonum inflatum occurs in the plot; surface stains (iron cemented fossiliferous material with mudstone undersurface) are present.

*Observations made by Scott Fisher, BLM staff.

Table B.7. (continued)

Sample No.	Depth(s)	Notes
6	0-2 and 2-6 cm	0-2 cm the shale platelets are less than 2 mm in diameter but seemingly well-weathered; Eriogonum inflatum occurs on the surface as litter; 2-6 cm has shale platelets 2-5 mm in diameter but these platelets have more extensive weathering than on many other sites; fine white precipitates occur at 3-5 cm in depth; surface polygonar plates are 3-6 mm in thickness and 8-10 x 10-15 cm in diameter.
7	0-2 cm	Many salt precipitates in the shale; 1-4 mm diameter shale platelets occur at 2 cm; hard indurated stones occur on the surface.
8	0-2 cm	Eriogonum inflatum occurs on the surface of the plot; channels occur 50 cm on each side of the shrub and are in a southwesterly direction; 0.5-1.5 cm shale particles occur at the base of these channels; large surface plates or polygons occur which are 8-15 mm in thickness and 8-12 x 10-15 cm in diameter.
9	0-2 cm	Some hard mudstone pebbles are found on the surface; shale platelets at 2 cm are 0.5-2 mm in diameter; surface polygons or plates are 3-7 mm in thickness and 6-10 x 8-12 cm in diameter; Atriplex corrugata occurs on the upslope edge of the plot.
10	0-2 cm	Surface plates have a hard dry consistency; mudstone which is quite hard occurs on the surface; small amount of shale is found at 2 cm and the platelets there are 0.5 mm in diameter; this horizon has the most extensive weathering incurred to date; Eriogonum inflatum occurs on the plot.
11	0-2 cm	Eriogonum inflatum present; 0.5-0.8 cm thick in the surface polygons or plates with diameters ranging from 6-10 to 8-12 cm; shale platelets 0.5-1.5 mm in diameter at 2 cm; the degree of weathering of the shale is as extensive as in site No. 10.
12	0-2 cm	White salt precipitates in the shale at 1 cm; Eriogonum inflatum present on the plot; 1-3 mm diameter shale platelets occur at 2 cm in depth; surface polygons or plates are 0.5-1.2 cm in thickness and 5-8 x 6-10 cm in diameter.

Table B.7. (continued)

Sample No.	Depth(s)	Notes
13	0-2 cm	Barren area; fossils which are indurated and the mudstone pebbles are found on the surface; 0.5-1.5 mm shale platelets occur at 2 cm; polygons or plates on the surface are 4-8 mm in thickness and 6-10 x 8-12 cm in diameter; a small drainage occurs 50 cm to the south which apparently has active surface erosion.
14	0-2 cm	*Eriogonum inflatum* is present on the plot; *Atriplex nuttallii* occurs slightly downslope; 0.5-2 mm shale platelets occur at 2 cm in depth; surface plates or polygons are 3-6 mm in thickness and 8-10 x 10-15 cm in diameter.
15	0-2 cm	The sample is taken within the confines of an *Atriplex nuttallii* site is located 50 feet east on alley No. 2.
16	0-2 cm	Sample within the confines of an *Atriplex nuttallii* plant; located 6 meters upslope in the third alley.
17	0-2 cm	Sample taken within the confines of *Atriplex corrugata*; located 1 meter southwest of site No. 8.
18	0-2 cm	Sample taken from within the confines of *Atriplex corrugata*; located 2 meters southeast of station No. 7.

Table B.8. Bulk Density Sample Data

		Bulk Density	
Replication	Bulk Density (gr/cc)	Mean	Std Dev
1	1.5	1.7	0.29
	2.0		
	1.5		
2	1.6	1.8	0.20
	1.8		
	2.0		
3	1.6	1.5	0.10
	1.5		
	1.4		
4	1.6	1.6	0.06
	1.6		
	1.5		
5	1.4	1.5	0.12
	1.6		
	1.4		
6	1.5	1.5	0.10
	1.6		
	1.4		
7	1.6	1.6	0.15
	1.4		
	1.7		
8	1.5	1.5	0.10
	1.6		
	1.4		
9	1.5	1.4	0.06
	1.4		
	1.4		
10	1.4	1.6	0.13
	1.7		
	1.6		
	1.6		
11	1.5	1.5	0.05
	1.5		
	1.5		
	1.6		

Table B.8. (continued)

Replication	Bulk Density (gr/cc)	Bulk Density	
		Mean	Std Dev
12	1.7	1.6	0.10
	1.5		
	1.6		
13	1.6	1.6	--
14	1.5	1.6	0.10
	1.6		
	1.7		
15	1.3	1.4	0.14
	1.5		

APPENDIX C

CHARACTERISTIC STATISTICS FOR FIELD DATA

Table C.1. Statistics by Run Type for Composite Electric Conductivity.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )
     RUN TYPE               MEAN          STD DEV    COEF OF SKEW     COEF OF VAR

           B1D              319.            177.              .5             .55
           B1W              321.            178.              .8             .55
           M1D              376.            195.             1.2             .52
           M1W              339.            199.             1.2             .59
           N1D              322.            108.             1.2             .34
           N1W              306.            185.             1.5             .60
           B2D              503.            311.              .9             .62
           B2W              433.            281.              .8             .65
           M2D              516.            285.             1.4             .55
           M2W              447.            279.              .8             .63
           N2D              442.            254.              .8             .58
           N2W              314.            168.             1.0             .54
           B3D              574.            382.              .6             .67
           B3W              543.            368.              .7             .68
           M3D              406.            261.             1.1             .64
           M3W              330.            227.             1.1             .69
           N3D              478.            244.              .2             .51
           N3W              397.            236.              .8             .60
           B4D              420.            196.              .3             .47
           B4W              458.            234.             -.1             .51
           M4D              805.            429.              .7             .53
           M4W              690.            379.              .6             .55
           N4D              606.            363.             1.5             .60
           N4W              482.            307.              .9             .64

     DRY RUNS           480.7000        136.3125           N= 12

     WET RUNS           421.6556        114.1560           N= 12
```

Table C.2. Statistics by Run Type for Time Weighted Average Electric Conductivity.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )
      RUN TYPE                MEAN              STD DEV    COEF OF SKEW     COEF OF VAR
           B1D                253.               127.               .4              .50
           B1W                247.               152.               .8              .61
           M1D                319.               174.              1.1              .54
           M1W                277.               160.              1.3              .58
           N1D                282.                86.              1.2              .30
           N1W                233.               141.              1.6              .60
           B2D                399.               250.               .9              .63
           B2W                351.               242.              1.0              .69
           M2D                414.               190.               .5              .46
           M2W                365.               235.               .8              .64
           N2D                354.               209.              1.2              .59
           N2W                257.               151.              1.2              .59
           B3D                552.               370.               .6              .67
           B3W                474.               342.               .8              .72
           M3D                336.               227.              1.3              .68
           M3W                268.               180.              1.2              .67
           N3D                385.               191.               .3              .49
           N3W                311.               182.               .7              .59
           B4D                353.               204.              1.1              .58
           B4W                364.               203.               .2              .56
           M4D                641.               325.               .5              .51
           M4W                544.               288.               .4              .53
           N4D                505.               307.              1.3              .61
           N4W                399.               242.               .8              .61

      DRY RUNS            399.4278          114.0134            N= 12

      WET RUNS            340.8011           95.9917            N= 12
```

Table C.3. Statistics by Run Type.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	8.3	.39	-.71	.05
B1W	8.4	.41	-.68	.05
M1D	8.4	.33	-.52	.04
M1W	8.4	.32	-.53	.04
N1D	8.1	.59	-1.81	.07
N1W	8.5	.39	-.65	.05
B2D	8.2	.34	.15	.04
B2W	8.3	.37	.36	.04
M2D	8.1	.37	.17	.05
M2W	8.2	.40	.53	.05
N2D	8.3	.36	.22	.04
N2W	8.4	.33	.13	.04
B3D	8.2	.39	-.26	.05
B3W	8.4	.44	-.49	.05
M3D	8.4	.29	-.13	.03
M3W	8.7	.24	.31	.03
N3D	8.4	.21	-.30	.03
N3W	8.5	.22	.30	.03
B4D	8.3	.35	-.40	.04
B4W	8.5	.35	.31	.04
M4D	8.2	.31	-.59	.04
M4W	8.3	.32	-.53	.04
N4D	8.3	.24	-.23	.03
N4W	8.5	.23	.22	.03
DRY RUNS	8.2733	.1004	N= 12	
WET RUNS	8.4294	.1233	N= 12	

Table C.4. Statistics by Run Type for Normalized Peak Runoff (ml/sec/cm/hr).

```
PEAK RUNOFF
     RUN TYPE              MEAN          STD DEV   COEF OF SKEW     COEF OF VAR
          B1D               1.5              .13            .53             .09
          B1W               1.5              .13            .34             .08
          M1D               1.3              .13            .70             .10
          M1W               1.4              .13            .71             .10
          N1D               1.4              .12          -.12              .09
          N1W               1.4              .14          -.65              .10
          B2D               1.4              .15          1.15              .10
          B2W               1.4              .11            .11             .08
          M2D               1.4              .15            .88             .11
          M2W               1.4              .20          1.55              .14
          N2D               1.3              .12            .90             .09
          N2W               1.4              .11          1.33              .08
          B3D               1.4              .09          -.54              .07
          B3W               1.5              .16          1.28              .11
          M3D               1.3              .17            .67             .13
          M3W               1.4              .13          1.41              .09
          N3D               1.3              .17          -.25              .13
          N3W               1.4              .10            .67             .07
          B4D               1.4              .14          -.73              .10
          B4W               1.5              .16          1.05              .11
          M4D               1.2              .12            .08             .10
          M4W               1.4              .12          -.27              .09
          N4D               1.3              .17          -.60              .13
          N4W               1.4              .20          -.45              .14

     DRY RUNS            1.3467            .0642         N= 12

     WET RUNS            1.4278            .0421         N= 12
```

Table C.5. Statistics by Run Type.

TOTAL RUNOFF VOLUME (ML)

RUN TYPE	MEAN	STD DEV	COFF OF SKEW	COFF OF VAR
B1D	14175.	1493.	-.6	.11
B1W	15603.	1419.	.2	.09
M1D	12582.	908.	.4	.07
M1W	14643.	1268.	.3	.09
N1D	13115.	1411.	-1.0	.11
N1W	14572.	1253.	-.1	.09
B2D	13637.	1606.	-.5	.12
B2W	15897.	1142.	.1	.07
M2D	13113.	1888.	-.6	.14
M2W	15041.	1137.	.4	.08
N2D	12306.	1528.	-.2	.12
N2W	14421.	1303.	.9	.09
B3D	12570.	1282.	.4	.10
B3W	15084.	1492.	.4	.10
M3D	11714.	1674.	-1.8	.14
M3W	14091.	1396.	-.9	.10
N3D	11498.	1738.	-.2	.15
N3W	14201.	979.	.3	.07
B4D	10944.	1968.	-.8	.18
B4W	13996.	2235.	-.9	.16
M4D	10060.	1506.	-.7	.15
M4W	13828.	1158.	.2	.08
N4D	10245.	1532.	-.2	.15
N4W	13834.	1321.	-.0	.10

DRY RUNS 12163.2389 1301.1986 N= 12

WET RUNS 14600.8944 681.9916 N= 12

Table C.6. Statistics By Run Type.

RAINFALL RATE (CM/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	6.23	.46	-.653	.074
B1W	6.23	.40	-.502	.064
M1D	6.39	.44	-.117	.069
M1W	6.61	.44	-.338	.066
N1D	6.53	.47	-1.267	.073
N1W	6.39	.44	-.562	.069
B2D	6.46	.41	.006	.063
B2W	6.73	.30	-1.956	.045
M2D	6.57	.64	-.970	.097
M2W	6.67	.37	.765	.055
N2D	6.57	.34	-.380	.052
N2W	6.53	.59	-.726	.090
B3D	6.61	.53	.181	.080
B3W	6.55	.53	-.731	.081
M3D	6.63	.61	.320	.091
M3W	6.41	.38	-.427	.059
N3D	6.70	.46	.124	.068
N3W	6.51	.29	.486	.045
B4D	6.49	.33	.432	.051
B4W	6.39	.48	-.047	.074
M4D	6.65	.37	-.102	.055
M4W	6.55	.30	.823	.046
N4D	6.74	.50	-.632	.075
N4W	6.56	.52	-1.191	.079
DRY RUNS	6.5473	.1420	N= 12	
WET RUNS	6.5090	.1376	N= 12	

Table C.7. Statistics By Run Type.

DURATION OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	30.82	.61	-.005	.020
B1W	30.90	1.05	.424	.034
M1D	31.21	.62	-.383	.020
M1W	31.17	1.11	-.114	.036
N1D	31.27	.69	.096	.022
N1W	30.82	.99	.667	.032
B2D	31.06	.85	.012	.027
B2W	31.34	1.01	-.577	.032
M2D	30.74	.74	.640	.024
M2W	30.74	1.01	.725	.033
N2D	30.89	.95	.443	.031
N2W	30.68	.93	.893	.030
B3D	31.16	.98	-.115	.032
B3W	30.49	.85	1.535	.028
M3D	31.20	1.32	-.406	.042
M3W	30.96	.94	.247	.030
N3D	30.60	.79	.794	.026
N3W	30.28	.39	1.491	.013
B4D	30.75	.92	.694	.030
B4W	30.28	.58	3.062	.019
M4D	30.50	.67	1.157	.022
M4W	30.23	.52	3.473	.017
N4D	30.55	.74	1.221	.024
N4W	30.39	.51	.575	.017
DRY RUNS	30.8959	.2776	N= 12	
WET RUNS	30.6895	.3654	N= 12	

Table C.8. Statistics By Run Type.

```
START OF RUNOFF (MINUTES)

     RUN TYPE              MEAN          STD DEV     COEF OF SKEW      COEF OF VAR

          B1D              2.07            .38            .865              .186
          B1W               .84            .33           1.026              .389
          M1D              2.38            .69           1.100              .290
          M1W               .89            .33           1.047              .371
          N1D              2.47           1.37           2.659              .557
          N1W               .89            .22            .787              .247
          B2D              2.14            .70          -.148               .326
          B2W               .87            .48           2.917              .552
          M2D              2.39            .92           1.127              .387
          M2W               .87            .17          -.749               .194
          N2D              2.82           1.03            .433              .365
          N2W               .99            .26            .283              .262
          B3D              3.21           1.14            .778              .356
          B3W               .94            .29            .632              .305
          M3D              4.56           1.98            .054              .435
          M3W              1.47            .86           1.186              .582
          N3D              3.56           1.52            .646              .427
          N3W              1.14            .44           2.085              .388
          B4D              4.63           1.42            .342              .307
          B4W              1.44            .85           1.627              .593
          M4D              4.66           2.53           1.249              .543
          M4W              1.16            .36            .425              .311
          N4D              4.87           1.96            .014              .403
          N4W              1.45            .50            .251              .343

     DRY RUNS            3.3137         1.0954         N= 12

     WET RUNS            1.0783          .2484         N= 12
```

Table C.9. Statistics By Run Type.

```
END OF RUNOFF (MINUTES)
     RUN TYPE              MEAN          STD DEV   COEFF OF SKEW   COEFF OF VAR

          B1D             31.47              .61          -.032            .019
          B1W             31.48             1.03           .293            .033
          M1D             31.74              .62          -.083            .019
          M1W             31.71             1.10          -.105            .035
          N1D             31.73              .71           .016            .022
          N1W             31.31             1.01           .683            .032
          B2D             31.62              .79          -.036            .025
          B2W             31.83              .97          -.541            .031
          M2D             31.30              .78           .614            .025
          M2W             31.27             1.00           .687            .032
          N2D             31.40              .92           .461            .029
          N2W             31.24              .84           .767            .027
          B3D             31.75             1.10           .032            .035
          B3W             31.00              .88          1.244            .029
          M3D             31.98             1.54          -.360            .048
          M3W             31.55             1.06           .188            .033
          N3D             31.30              .90           .461            .029
          N3W             30.93              .47           .681            .015
          B4D             31.41              .91           .338            .029
          B4W             30.89              .62          2.179            .020
          M4D             31.14              .71           .477            .023
          M4W             30.76              .54          2.807            .018
          N4D             31.13              .85          1.476            .027
          N4W             31.00              .56           .475            .018

     DRY RUNS           31.4966            .2665          N= 12

     WET RUNS           31.2473            .3421          N= 12
```

Table C.10. Statistics By Run Type.

```
INFILTRATION RATE (IN/HR)

      RUN TYPE             MEAN            STD DEV    COEF OF SKEW     COEF OF VAR

          B1D               .58               .17         -.081               .286
          B1W               .40               .21          .476               .540
          M1D               .87               .17         -.964               .191
          M1W               .69               .15          .498               .216
          N1D               .86               .21         -.337               .240
          N1W               .59               .22          .936               .363
          B2D               .76               .21         -.620               .279
          B2W               .58               .17         -.450               .297
          M2D               .85               .22        -1.173               .252
          M2W               .63               .19         -.775               .308
          N2D               .96               .22         -.101               .228
          N2W               .66               .19         -.466               .287
          B3D               .96               .17          .126               .173
          B3W               .56               .22         -.902               .382
          M3D              1.08               .32         -.045               .297
          M3W               .67               .17          .285               .256
          N3D              1.11               .26         -.302               .230
          N3W               .66               .13         -.199               .201
          B4D              1.11               .28          .555               .256
          B4W               .63               .29          .664               .454
          M4D              1.27               .22         -.158               .176
          M4W               .72               .16          .437               .219
          N4D              1.28               .24          .517               .190
          N4W               .73               .25          .640               .346
                                                  ----------------------------------

      DRY RUNS           .9757            .2072       N= 12

      WET RUNS           .6281            .0894       N= 12
```

Table C.11. Statistics by Plot Type for Composite Electric Conductivity.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )
     RUN TYPE              MEAN            STD DEV   COFF OF SKEW    COEF OF VAR
          B1               320.              174.             .6             .54
          M1               357.              195.            1.2             .54
          N1               314.              149.            1.4             .47
          B2               468.              294.             .9             .63
          M2               482.              280.            1.1             .58
          N2               378.              222.            1.1             .59
          B3               559.              369.             .7             .66
          M3               368.              244.            1.1             .66
          N3               438.              240.             .4             .55
          B4               439.              213.             .1             .48
          M4               747.              402.             .7             .54
          N4               544.              336.            1.3             .62

     ALL RUNS          451.1778          123.0440          N= 12
```

Table C.12. Statistics by Plot Type for Time Weighted Average Electric Conductivity.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )
     RUN TYPE              MEAN            STD DEV   COFF OF SKEW    COEF OF VAR
          B1               250.              138.             .6             .55
          M1               298.              166.            1.2             .56
          N1               258.              117.            1.2             .46
          B2               375.              243.             .9             .65
          M2               389.              211.             .6             .54
          N2               306.              186.            1.4             .61
          B3               513.              352.             .7             .69
          M3               302.              204.            1.3             .68
          N3               348.              187.             .5             .54
          B4               358.              200.             .7             .56
          M4               592.              306.             .5             .52
          N4               452.              277.            1.2             .61

     ALL RUNS          370.1144          103.8589          N= 12
```

Table C.13. Statistics by Plot Type.

```
PH

        RUN TYPE              MEAN          STD DEV    COEFF OF SKEW     COEFF OF VAR

          B1                   8.4             .39           -.65               .05
          M1                   8.4             .33           -.51               .04
          N1                   8.3             .52          -1.75               .06
          B2                   8.3             .36            .31               .04
          M2                   8.1             .38            .39               .05
          N2                   8.4             .34            .14               .04
          B3                   8.3             .42           -.28               .05
          M3                   8.5             .29           -.20               .03
          N3                   8.5             .23            .03               .03
          B4                   8.4             .36           -.04               .04
          M4                   8.2             .31           -.50               .04
          N4                   8.4             .24           -.04               .03

        ALL RUNS            8.3514           .1059         N= 12
```

Table C.14. Statistics by Plot Type for Normalized Peak Runoff (ml/sec/cm/hr).

```
PEAK RUNOFF

        RUN TYPE              MEAN          STD DEV    COEFF OF SKEW     COEFF OF VAR

          B1                   1.5             .13            .40               .09
          M1                   1.3             .14            .63               .10
          N1                   1.4             .13           -.37               .10
          B2                   1.4             .13            .99               .09
          M2                   1.4             .18           1.41               .12
          N2                   1.4             .12            .94               .09
          B3                   1.4             .14           1.37               .10
          M3                   1.4             .16            .51               .12
          N3                   1.4             .14           -.50               .10
          B4                   1.4             .16            .37               .11
          M4                   1.3             .14           -.05               .11
          N4                   1.3             .19           -.29               .14

        ALL RUNS            1.3872           .0487         N= 12
```

Table C.15. Statistics by Plot Type.

TOTAL RUNOFF VOLUME (ML)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	14889.	1605.	-.2	.11
M1	13612.	1507.	.5	.11
N1	13843.	1506.	-.5	.11
B2	14767.	1787.	-.5	.12
M2	14077.	1818.	-.8	.13
N2	13364.	1762.	-.1	.13
B3	13827.	1872.	.3	.14
M3	12903.	1938.	-.9	.15
N3	12849.	1952.	-.6	.15
B4	12470.	2587.	-.3	.21
M4	11944.	2327.	-.3	.19
N4	12039.	2304.	-.2	.19
ALL RUNS	13382.0667	970.0980	N= 12	

Table C.16. Statistics by Plot Type.

RAINFALL RATE (CM/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	6.23	.43	-.587	.068
M1	6.50	.45	-.212	.069
N1	6.46	.46	-.870	.071
B2	6.59	.38	-.741	.057
M2	6.62	.51	-.870	.077
N2	6.55	.47	-.789	.072
B3	6.58	.52	-.268	.079
M3	6.52	.51	.457	.078
N3	6.60	.39	.494	.059
B4	6.44	.41	-.065	.063
M4	6.60	.33	.304	.050
N4	6.65	.51	-.888	.077
ALL RUNS	6.5281	.1154	N= 12	

Table C.17. Statistics by Plot Type.

DURATION OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	30.86	.85	.451	.027
M1	31.19	.88	-.206	.028
N1	31.05	.87	.218	.028
B2	31.20	.93	-.265	.030
M2	30.74	.87	.719	.028
N2	30.78	.93	.644	.030
B3	30.83	.96	.568	.031
M3	31.08	1.13	-.129	.036
N3	30.44	.64	1.327	.021
B4	30.51	.79	1.425	.026
M4	30.36	.60	1.920	.020
N4	30.47	.63	1.208	.021
ALL RUNS	30.7927	.2966	N= 12	

Table C.18. Statistics by Plot Type.

START OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	1.45	.72	.213	.493
M1	1.64	.93	.749	.566
N1	1.68	1.26	2.718	.750
B2	1.51	.88	.555	.582
M2	1.63	1.01	1.307	.622
N2	1.90	1.19	.943	.624
B3	2.08	1.42	.927	.681
M3	3.02	2.17	.775	.720
N3	2.35	1.65	1.106	.704
B4	3.03	1.99	.509	.656
M4	2.91	2.52	1.629	.864
N4	3.16	2.24	.830	.708
ALL RUNS	2.1960	.6655	N= 12	

Table C.19. Statistics by Plot Type.

END OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	31.47	.83	.261	.026
M1	31.72	.88	-.136	.028
N1	31.52	.88	.244	.028
B2	31.73	.88	-.283	.028
M2	31.28	.88	.655	.028
N2	31.32	.87	.603	.028
B3	31.37	1.05	.568	.034
M3	31.76	1.32	-.049	.041
N3	31.12	.73	.909	.023
B4	31.15	.81	1.006	.026
M4	30.95	.65	1.268	.021
N4	31.07	.71	1.401	.023
ALL RUNS	31.3719	.2752	N= 12	

Table C.20. Statistics by Plot Type.

INFILTRATION RATE (IN/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	.49	.21	-.056	.430
M1	.78	.18	-.102	.230
N1	.73	.25	.146	.342
B2	.67	.21	-.210	.312
M2	.74	.23	-.550	.310
N2	.81	.25	.052	.313
B3	.76	.28	-.451	.363
M3	.87	.33	.644	.377
N3	.88	.30	.484	.345
B4	.87	.37	.245	.425
M4	1.00	.34	.267	.340
N4	1.01	.37	.124	.368
ALL RUNS	.8019	.1425	N= 12	

DATA IS GROUPED BY REPLICATION INCLUDING DRY AND WET RUNS

Table C.21. Composite Electric Conductivity Statistics by Replication for All Runs.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )

    RUN TYPE                MEAN            STD DEV    COEF OF SKEW     COEF OF VAR

        REP  1              480.             238.              .6               .50
        REP  2              455.             343.             1.9               .75
        REP  3              455.             302.             1.0               .66
        REP  4              412.             254.              .9               .62
        REP  5              421.             202.             1.0               .48
        REP  6              339.             166.             1.1               .49
        REP  7              609.             435.             1.0               .71
        REP  8              376.             261.             1.3               .70
        REP  9              632.             283.              .3               .45
        REP10               436.             203.             1.4               .47
        REP11               420.             329.             1.2               .78
        REP12               434.             263.              .4               .60
        REP13               555.             328.              .7               .59
        REP14               353.             254.             2.0               .72
        REP15               390.             295.             2.2               .76

    ALL REPS            451.1778         86.7160           N= 15
```

Table C.22. Time Weighted Average Electric Conductivity Statistics by Replication for All Runs.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )

    RUN TYPE                MEAN            STD DEV    COEF OF SKEW     COEF OF VAR

        REP  1              422.             229.              .7               .54
        REP  2              366.             266.             1.9               .73
        REP  3              340.             220.             1.2               .65
        REP  4              408.             310.             1.4               .76
        REP  5              340.             187.             1.3               .55
        REP  6              263.             117.             1.0               .44
        REP  7              498.             330.              .9               .66
        REP  8              303.             225.             1.4               .74
        REP  9              520.             251.              .5               .48
        REP10               360.             171.             1.5               .48
        REP11               338.             272.             1.3               .81
        REP12               351.             220.              .3               .63
        REP13               431.             227.              .2               .53
        REP14               284.             197.             1.9               .70
        REP15               327.             252.             2.3               .77

    ALL REPS            370.1144         73.3743           N= 15
```

Table C.23. Statistics by Replication for All Runs.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	8.4	.30	-.54	.04
REP 2	8.3	.50	-2.42	.06
REP 3	8.4	.39	-.45	.05
REP 4	8.1	.35	.40	.04
REP 5	8.1	.38	.33	.05
REP 6	8.2	.35	.10	.04
REP 7	8.4	.29	-.25	.03
REP 8	8.5	.36	-.48	.04
REP 9	8.3	.33	-.59	.04
REP10	8.2	.33	-.32	.04
REP11	8.4	.40	.05	.05
REP12	8.3	.31	-.41	.04
REP13	8.4	.21	.79	.03
REP14	8.6	.26	.00	.03
REP15	8.6	.24	.77	.03
ALL REPS	8.3514	.1486	N= 15	

Table C.24. Normalized Peak Runoff (ml/sec/cm/hr) Statistics by Replication for All Runs.

PEAK RUNOFF

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	1.5	.15	.17	.10
REP 2	1.4	.13	-.04	.09
REP 3	1.4	.13	-1.06	.10
REP 4	1.4	.10	-.08	.07
REP 5	1.4	.09	.00	.07
REP 6	1.4	.13	.59	.09
REP 7	1.4	.18	.89	.13
REP 8	1.4	.15	.60	.11
REP 9	1.5	.15	.44	.10
REP10	1.3	.11	.17	.09
REP11	1.3	.14	-.60	.11
REP12	1.3	.11	-.34	.09
REP13	1.4	.15	1.79	.11
REP14	1.3	.16	-.70	.12
REP15	1.4	.21	.56	.15
ALL REPS	1.3872	.0621	N= 15	

Table C.25. Statistics by Replication for All Runs.

TOTAL RUNOFF VOLUME (ML)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	14303.	1963.	-.6	.14
REP 2	13894.	1690.	.2	.12
REP 3	13642.	2797.	-.6	.21
REP 4	13524.	1416.	-.4	.10
REP 5	12922.	2176.	-.6	.17
REP 6	14425.	2113.	-.4	.15
REP 7	13474.	2114.	-1.1	.16
REP 8	12710.	1876.	-.7	.15
REP 9	14414.	2290.	-.9	.16
REP10	12230.	1976.	-.6	.16
REP11	12615.	2286.	-.8	.18
REP12	13334.	1972.	-.2	.15
REP13	13179.	1807.	-.8	.14
REP14	13123.	2568.	-.6	.20
REP15	12941.	1461.	-.5	.11
ALL REPS	13382.0667	667.6843	N= 15	

Table C.26. Statistics by Replication for All Runs.

RAINFALL RATE (CM/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	6.33	.64	-.417	.102
REP 2	6.48	.49	-.879	.075
REP 3	6.49	.41	-1.395	.063
REP 4	6.48	.22	-.372	.035
REP 5	6.50	.35	-.190	.053
REP 6	6.76	.25	.530	.037
REP 7	6.50	.31	-.652	.047
REP 8	6.24	.49	.173	.078
REP 9	6.65	.43	-.095	.065
REP10	6.57	.32	.031	.048
REP11	6.35	.46	-.624	.073
REP12	6.91	.43	-.221	.062
REP13	6.48	.45	-.125	.070
REP14	6.61	.40	.027	.060
REP15	6.57	.65	.280	.100
ALL REPS	6.5281	.1665	N= 15	

Table C.27. Statistics by Replication for All Runs.

DURATION OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	30.68	.74	.630	.024
REP 2	31.21	.92	-.127	.030
REP 3	31.14	.91	-.078	.029
REP 4	30.22	.76	.595	.025
REP 5	30.95	.98	1.056	.032
REP 6	30.92	.91	.357	.029
REP 7	30.19	.53	2.195	.017
REP 8	31.13	.87	-.092	.028
REP 9	30.74	.82	.825	.027
REP10	30.37	.69	1.804	.023
REP11	31.36	.94	-.430	.030
REP12	30.63	.77	1.066	.025
REP13	30.35	.73	2.134	.024
REP14	31.20	.83	-.077	.027
REP15	30.81	.82	.617	.026
ALL REPS	30.7927	.3819	N= 15	

Table C.28. Statistics by Replication for All Runs.

START OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	1.80	1.42	2.335	.790
REP 2	1.82	1.53	2.293	.843
REP 3	2.61	1.97	1.348	.752
REP 4	1.35	.79	.682	.583
REP 5	2.73	2.13	.883	.780
REP 6	2.07	1.45	.857	.702
REP 7	1.63	1.25	2.206	.767
REP 8	2.44	2.03	1.446	.833
REP 9	2.55	2.43	2.368	.950
REP10	1.88	1.28	1.261	.682
REP11	2.30	1.38	.623	.600
REP12	2.87	2.06	.861	.717
REP13	1.78	.96	.554	.543
REP14	2.29	1.77	1.003	.776
REP15	2.82	1.77	1.151	.625
ALL REPS	2.1960	.4734	N= 15	

Table C.29. Statistics by Replication for All Runs.

END OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	31.18	.74	.630	.024
REP 2	31.68	.91	-.154	.029
REP 3	31.66	.89	-.111	.028
REP 4	30.81	.84	.560	.027
REP 5	31.43	.98	1.054	.031
REP 6	31.42	.91	.357	.029
REP 7	30.69	.53	2.195	.017
REP 8	31.77	.84	-.028	.026
REP 9	31.22	.87	.841	.028
REP10	31.20	.94	1.415	.030
REP11	32.06	.93	-.316	.029
REP12	31.01	.73	1.041	.024
REP13	31.40	.91	1.482	.029
REP14	31.85	.83	-.260	.026
REP15	31.21	.82	.520	.026
ALL REPS	31.3719	.3858	N= 15	

Table C.30. Statistics by Replication for All Runs.

INFILTRATION RATE (IN/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.59	.36	.637	.616
REP 2	.74	.29	.570	.388
REP 3	.78	.33	1.083	.426
REP 4	.73	.24	.238	.327
REP 5	.86	.28	.693	.321
REP 6	.77	.28	.629	.362
REP 7	.74	.32	1.084	.430
REP 8	.80	.25	.620	.310
REP 9	.71	.32	.454	.451
REP10	.95	.28	.473	.291
REP11	.86	.29	.966	.339
REP12	.95	.26	.520	.270
REP13	.78	.31	.041	.398
REP14	.89	.34	.468	.385
REP15	.88	.36	.333	.414
ALL REPS	.8019	.0972	N= 15	

Table C.31. Composite Electric Conductivity Statistics by Replication for Dry Runs.

ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	534.	250.	.6	.47
REP 2	520.	404.	1.8	.78
REP 3	492.	326.	.6	.66
REP 4	412.	247.	1.1	.60
REP 5	478.	229.	.8	.48
REP 6	378.	183.	1.0	.49
REP 7	640.	477.	1.3	.75
REP 8	394.	258.	1.3	.66
REP 9	631.	283.	.6	.45
REP10	451.	171.	1.2	.38
REP11	435.	354.	1.4	.81
REP12	425.	264.	.6	.62
REP13	633.	367.	.7	.58
REP14	376.	251.	2.1	.67
REP15	412.	287.	2.1	.70
DRY REPS	480.7000	92.6035	N= 15	

Table C.32. Time Weighted Average Electric Conductivity Statistics by Replication for Dry Runs.

ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	488.	250.	.6	.51
REP 2	423.	310.	1.9	.73
REP 3	375.	238.	.9	.64
REP 4	444.	333.	1.5	.75
REP 5	386.	218.	1.0	.57
REP 6	285.	123.	.9	.43
REP 7	527.	359.	1.1	.68
REP 8	321.	221.	1.3	.69
REP 9	527.	260.	.8	.49
REP10	376.	147.	1.2	.39
REP11	352.	289.	1.4	.82
REP12	358.	232.	.5	.65
REP13	468.	228.	.2	.49
REP14	312.	205.	1.9	.66
REP15	349.	247.	2.2	.71
DRY REPS	399.4278	76.6946	N= 15	

Table C.33. Statistics by Replication for Dry Runs.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	8.3	.30	-.86	.04
REP 2	8.2	.64	-2.17	.08
REP 3	8.4	.41	-.44	.05
REP 4	8.1	.34	.45	.04
REP 5	8.1	.39	.33	.05
REP 6	8.1	.36	.35	.04
REP 7	8.3	.30	-.26	.04
REP 8	8.4	.38	-.79	.05
REP 9	8.3	.29	-.54	.04
REP10	8.1	.33	-.17	.04
REP11	8.2	.39	.21	.05
REP12	8.3	.33	-.12	.04
REP13	8.3	.13	-.08	.02
REP14	8.5	.21	-.13	.03
REP15	8.5	.19	-.80	.02
DRY REPS	8.2733	.1307	N= 15	

Table C.34. Normalized Peak Runoff (ml/sec/cm/hr) Statistics by Replication for Dry Runs.

PEAK RUNOFF

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	1.5	.16	.56	.11
REP 2	1.5	.15	-.09	.10
REP 3	1.4	.16	-.62	.12
REP 4	1.4	.09	-.13	.06
REP 5	1.3	.07	.00	.06
REP 6	1.4	.14	.75	.10
REP 7	1.4	.15	-1.13	.11
REP 8	1.3	.17	.87	.13
REP 9	1.4	.15	.44	.10
REP10	1.3	.12	.38	.10
REP11	1.3	.14	-.54	.11
REP12	1.3	.15	.00	.11
REP13	1.3	.11	.23	.08
REP14	1.3	.14	-.77	.11
REP15	1.3	.16	.01	.12
DRY REPS	1.3467	.0675	N= 15	

Table C.35. Statistics by Replication for Dry Runs.

TOTAL RUNOFF VOLUME (ML)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	13441.	2013.	-.5	.15
REP 2	12943.	1272.	-.9	.10
REP 3	11806.	2328.	-.8	.20
REP 4	12487.	1111.	.3	.09
REP 5	11490.	1931.	-.7	.17
REP 6	12989.	1740.	-.6	.13
REP 7	12094.	2078.	-.8	.17
REP 8	11502.	1705.	-.5	.15
REP 9	13254.	2473.	-.7	.19
REP10	11170.	1898.	-.0	.17
REP11	11228.	2172.	-.5	.19
REP12	12675.	1953.	.0	.15
REP13	11944.	1670.	-.4	.14
REP14	11518.	2398.	-.1	.21
REP15	11908.	1103.	-.8	.09
DRY REPS	12163.2389	750.7557	N= 15	

Table C.36. Statistics by Replication for Dry Runs.

RAINFALL RATE (CM/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	6.48	.62	-.367	.096
REP 2	6.42	.58	-.653	.091
REP 3	6.43	.53	-1.230	.082
REP 4	6.51	.23	-.494	.036
REP 5	6.54	.37	.290	.056
REP 6	6.81	.28	1.028	.042
REP 7	6.47	.28	-1.128	.043
REP 8	6.16	.46	.207	.074
REP 9	6.72	.47	-.114	.070
REP10	6.60	.36	-.135	.055
REP11	6.28	.39	-1.350	.063
REP12	6.98	.41	-.649	.058
REP13	6.52	.43	.376	.066
REP14	6.62	.41	-.746	.062
REP15	6.68	.69	.393	.103
DRY REPS	6.5473	.2045	N= 15	

Table C.37. Statistics by Replication for Dry Runs.

DURATION OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	30.98	.72	.037	.023
REP 2	31.38	.74	-.741	.024
REP 3	30.68	.79	.904	.026
REP 4	30.45	1.05	-.200	.034
REP 5	30.93	1.07	1.580	.035
REP 6	30.73	.73	.564	.024
REP 7	30.29	.69	1.513	.023
REP 8	31.40	.62	-.166	.020
REP 9	30.96	.84	.388	.027
REP10	30.53	.78	1.184	.025
REP11	31.73	.67	-1.363	.021
REP12	30.78	.78	.650	.025
REP13	30.58	.97	1.261	.032
REP14	31.08	.65	.123	.021
REP15	30.93	.82	.321	.027
DRY REPS	30.8959	.3905	N= 15	

Table C.38. Statistics by Replication for Dry Runs.

START OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	2.60	1.66	1.630	.639
REP 2	2.69	1.79	1.570	.666
REP 3	3.87	1.96	1.150	.507
REP 4	1.96	.66	.003	.337
REP 5	4.19	1.96	.471	.466
REP 6	3.17	1.28	.203	.404
REP 7	2.48	1.30	2.277	.523
REP 8	3.79	2.11	.801	.556
REP 9	3.95	2.82	1.711	.713
REP10	2.78	1.21	1.082	.433
REP11	3.43	.96	.922	.279
REP12	4.53	1.65	.480	.364
REP13	2.58	.68	.278	.263
REP14	3.64	1.59	.388	.436
REP15	4.06	1.66	.934	.410
DRY REPS	3.3137	.7629	N= 15	

Table C.39. Statistics by Replication for Dry Runs.

END OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	31.48	.72	.037	.023
REP 2	31.90	.73	-.631	.023
REP 3	31.18	.79	.904	.025
REP 4	31.11	1.13	-.383	.036
REP 5	31.40	1.08	1.652	.034
REP 6	31.23	.73	.564	.023
REP 7	30.79	.69	1.513	.022
REP 8	32.03	.66	.302	.021
REP 9	31.44	.89	.429	.028
REP10	31.43	1.04	1.119	.033
REP11	32.42	.74	-.910	.023
REP12	31.12	.75	.698	.024
REP13	31.79	1.09	.812	.034
REP14	31.77	.69	-.412	.022
REP15	31.36	.80	.403	.025
DRY REPS	31.4966	.4180	N= 15	

Table C.40. Statistics by Replication for Dry Runs.

INFILTRATION RATE (IN/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.79	.38	.011	.488
REP 2	.85	.33	.205	.394
REP 3	.96	.33	.828	.348
REP 4	.89	.19	-.200	.212
REP 5	1.06	.25	-.064	.233
REP 6	.96	.25	.052	.256
REP 7	.92	.32	1.048	.349
REP 8	.94	.23	.724	.249
REP 9	.90	.30	.138	.337
REP10	1.11	.26	-.114	.237
REP11	1.03	.29	.950	.280
REP12	1.08	.27	-.058	.255
REP13	.98	.27	.005	.276
REP14	1.10	.31	.157	.281
REP15	1.06	.35	.331	.327
DRY REPS	.9757	.0965	N= 15	

Table C.41. Composite Electric Conductivity Statistics by Replication for Wet Runs.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )

   RUN TYPE             MEAN          STD DEV    COEFF OF SKEW     COEFF OF VAR

      REP  1            426.            221.              .5              .52
      REP  2            391.            270.             1.7              .69
      REP  3            419.            286.             1.6              .68
      REP  4            412.            273.              .8              .66
      REP  5            363.            160.              .7              .44
      REP  6            300.            145.             1.0              .48
      REP  7            579.            406.              .7              .70
      REP  8            358.            275.             1.4              .77
      REP  9            633.            295.             -.0              .47
      REP10             421.            237.             1.6              .56
      REP11             404.            318.             1.1              .79
      REP12             444.            273.              .2              .62
      REP13             478.            277.              .2              .58
      REP14             329.            265.             2.1              .81
      REP15             368.            314.             2.4              .85

   WET REPS          421.6556         87.9804          N= 15
```

Table C.42. Time Weighted Average Electric Conductivity Statistics by Replication for Wet Runs.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )

   RUN TYPE             MEAN          STD DEV    COEFF OF SKEW     COEFF OF VAR

      REP  1            356.            193.              .6              .54
      REP  2            309.            211.             1.3              .68
      REP  3            304.            203.             1.5              .67
      REP  4            373.            296.             1.4              .79
      REP  5            294.            145.             1.1              .49
      REP  6            242.            112.             1.2              .46
      REP  7            468.            312.              .5              .67
      REP  8            284.            236.             1.5              .83
      REP  9            514.            253.              .2              .49
      REP10             344.            198.             1.8              .57
      REP11             323.            267.             1.3              .83
      REP12             344.            217.              .1              .63
      REP13             394.            230.              .2              .58
      REP14             255.            195.             2.1              .76
      REP15             306.            265.             2.5              .87

   WET REPS          340.8011         74.0758          N= 15
```

Table C.43. Statistics by Replication for Wet Runs.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	8.5	.31	-.39	.04
REP 2	8.4	.32	-.55	.04
REP 3	8.5	.38	-.45	.05
REP 4	8.1	.38	.34	.05
REP 5	8.2	.38	.38	.05
REP 6	8.2	.35	-.13	.04
REP 7	8.5	.24	.36	.03
REP 8	8.6	.34	.02	.04
REP 9	8.4	.36	-.90	.04
REP10	8.3	.31	-.48	.04
REP11	8.5	.38	-.08	.05
REP12	8.4	.27	-.61	.03
REP13	8.5	.23	.43	.03
REP14	8.7	.24	-.28	.03
REP15	8.7	.26	1.08	.03
WET REPS	8.4294	.1710	N= 15	

Table C.44. Normalized Peak Runoff (ml/sec/cm/hr) Statistics by Replication for Wet Runs.

PEAK RUNOFF

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	1.6	.12	.33	.07
REP 2	1.4	.12	-.19	.09
REP 3	1.4	.10	-1.36	.07
REP 4	1.5	.09	-.13	.06
REP 5	1.4	.07	.00	.05
REP 6	1.5	.12	.77	.09
REP 7	1.5	.19	1.75	.13
REP 8	1.4	.14	.61	.10
REP 9	1.5	.14	.64	.10
REP10	1.3	.09	.37	.07
REP11	1.4	.13	-.85	.09
REP12	1.3	.07	-.40	.05
REP13	1.4	.17	1.84	.12
REP14	1.4	.15	-1.20	.11
REP15	1.5	.24	.30	.16
WET REPS	1.4278	.0637	N= 15	

Table C.45. Statistics by Replication for Wet Runs.

TOTAL RUNOFF VOLUME (ML)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	15166.	1544.	-.3	.10
REP 2	14846.	1542.	.3	.10
REP 3	15477.	1895.	-1.1	.12
REP 4	14561.	780.	-1.6	.05
REP 5	14353.	1304.	-.1	.09
REP 6	15861.	1347.	.4	.08
REP 7	14854.	932.	-.4	.06
REP 8	13919.	1125.	-.2	.08
REP 9	15573.	1384.	.4	.09
REP10	13291.	1454.	-1.5	.11
REP11	14003.	1417.	-1.0	.10
REP12	13993.	1836.	-.3	.13
REP13	14415.	841.	.5	.06
REP14	14729.	1554.	-.4	.11
REP15	13974.	960.	-1.3	.07
WET REPS	14600.8944	715.1092	N= 15	

Table C.46. Statistics by Replication for Wet Runs.

RAINFALL RATE (CM/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	6.17	.65	-.495	.105
REP 2	6.55	.38	-.898	.058
REP 3	6.55	.25	.726	.039
REP 4	6.45	.22	-.308	.035
REP 5	6.47	.34	-.880	.052
REP 6	6.71	.21	-1.130	.032
REP 7	6.54	.34	-.551	.052
REP 8	6.33	.52	.046	.083
REP 9	6.57	.39	-.402	.059
REP10	6.54	.27	.156	.042
REP11	6.43	.53	-.565	.083
REP12	6.83	.46	.166	.067
REP13	6.44	.49	-.421	.076
REP14	6.60	.40	.889	.060
REP15	6.46	.63	.061	.097
WET REPS	6.5090	.1541	N= 15	

Table C.47. Statistics by Replication for Wet Runs.

```
DURATION OF RUNOFF (MINUTES)
    RUN TYPE              MEAN          STD DEV   COEF OF SKEW     COEF OF VAR

      REP  1              30.38            .64         1.618            .021
      REP  2              31.03           1.08          .350            .035
      REP  3              31.60            .80        -1.169            .025
      REP  4              30.00            .01         1.044            .000
      REP  5              30.97            .93          .320            .030
      REP  6              31.10           1.06          .006            .034
      REP  7              30.08            .29         3.149            .010
      REP  8              30.85           1.01          .466            .033
      REP  9              30.52            .78         1.487            .026
      REP10               30.20            .57         3.116            .019
      REP11               30.99           1.05          .361            .034
      REP12               30.48            .77         1.659            .025
      REP13               30.13            .28         3.007            .009
      REP14               31.32           1.00         -.354            .032
      REP15               30.70            .83          .982            .027

    WET REPS            30.6895          .4829        N= 15
```

Table C.48. Statistics by Replication for Wet Runs.

```
START OF RUNOFF (MINUTES)
    RUN TYPE              MEAN          STD DEV   COEF OF SKEW     COEF OF VAR

      REP  1              1.00             .22          .368            .222
      REP  2               .94             .21         1.359            .227
      REP  3              1.36             .88         1.454            .648
      REP  4               .75             .26          .047            .345
      REP  5              1.27            1.01         1.662            .790
      REP  6               .98             .41          .706            .416
      REP  7               .79             .21         1.327            .271
      REP  8              1.09             .43         1.379            .397
      REP  9              1.16             .35          .171            .301
      REP10                .97             .45         2.178            .457
      REP11               1.16             .49         1.922            .419
      REP12               1.21             .33          .095            .272
      REP13                .97             .29          .264            .294
      REP14                .94             .32         1.836            .344
      REP15               1.59             .66          .624            .417

    WET REPS             1.0783          .2199        N= 15
```

Table C.49. Statistics by Replication for Wet Runs.

END OF RUNOFF (MINUTES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	30.88	.64	1.618	.021
REP 2	31.47	1.06	.332	.034
REP 3	32.15	.71	-1.186	.022
REP 4	30.50	.01	1.044	.000
REP 5	31.45	.92	.162	.029
REP 6	31.60	1.06	.006	.033
REP 7	30.58	.29	3.149	.009
REP 8	31.51	.94	.310	.030
REP 9	30.99	.82	1.471	.026
REP10	30.98	.81	1.880	.026
REP11	31.71	.99	.327	.031
REP12	30.90	.73	1.515	.024
REP13	31.01	.45	1.232	.014
REP14	31.92	.98	-.328	.031
REP15	31.06	.85	.758	.027
WET REPS	31.2473	.4821	N= 15	

Table C.50. Statistics by Replication for Wet Runs.

INFILTRATION RATE (IN/HR)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.40	.22	.418	.555
REP 2	.64	.19	-.616	.301
REP 3	.59	.20	1.247	.339
REP 4	.56	.15	.419	.270
REP 5	.66	.10	-.298	.156
REP 6	.57	.13	.025	.224
REP 7	.57	.20	.779	.360
REP 8	.66	.17	.039	.266
REP 9	.51	.19	-1.154	.373
REP10	.78	.18	.606	.226
REP11	.69	.18	.257	.260
REP12	.83	.17	.181	.202
REP13	.59	.22	-1.099	.376
REP14	.69	.24	.874	.354
REP15	.69	.28	-.124	.411
WET REPS	.6281	.1062	N= 15	

Table C.51. Composite Electric Conductivity Statistics by Trampling Level.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )
      RUN TYPE              MEAN          STD DEV    COEF OF SKEW    COEF OF VAR
    TRAMPLING1              331.            173.          1.1            .52
    TRAMPLING2              442.            268.          1.0            .61
    TRAMPLING3              455.            298.          1.0            .65
    TRAMPLING4              577.            348.          1.1            .60

  ALL TRAMPLING          451.1778        100.7557        N=   4
```

Table C.52. Time Weighted Average Electric Conductivity Statistics by Trampling Level.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM )
      RUN TYPE              MEAN          STD DEV    COEF OF SKEW    COEF OF VAR
    TRAMPLING1              268.            142.          1.1            .53
    TRAMPLING2              357.            215.          1.0            .60
    TRAMPLING3              388.            272.          1.3            .70
    TRAMPLING4              467.            279.           .9            .60

  ALL TRAMPLING          370.1144         82.2291        N=   4
```

Table C.53. Statistics by Trampling Level.

```
PH
      RUN TYPE              MEAN          STD DEV    COEF OF SKEW    COEF OF VAR
    TRAMPLING1              8.4             .42         -1.42            .05
    TRAMPLING2              8.3             .37           .20            .04
    TRAMPLING3              8.4             .34         -.57             .04
    TRAMPLING4              8.4             .31         -.22             .04

  ALL TRAMPLING            8.3514          .0666        N=   4
```

Table C.54. Normalized Peak Runoff (ml/sec/cm/hr) Statistics by Trampling Level.

```
PEAK RUNOFF

        RUN TYPE                 MEAN          STD DEV   COEF OF SKEW     COEF OF VAR

      TRAMPLING1                  1.4              .15            .16             .10
      TRAMPLING2                  1.4              .15           1.27             .10
      TRAMPLING3                  1.4              .15            .38             .11
      TRAMPLING4                  1.4              .17           -.04             .12

   ALL TRAMPLING               1.3872            .0210          N=  4
```

Table C.55. Statistics by Trampling Level.

```
TOTAL RUNOFF VOLUME (ML)

        RUN TYPE                 MEAN          STD DEV   COEF OF SKEW     COEF OF VAR

      TRAMPLING1               14115.            1622.            -.0             .11
      TRAMPLING2               14069.            1861.            -.4             .13
      TRAMPLING3               13193.            1952.            -.4             .15
      TRAMPLING4               12151.            2393.            -.2             .20

   ALL TRAMPLING           13382.0667         923.7162          N=  4
```

Table C.56. Statistics by Trampling Level.

```
RAINFALL RATE (CM/HR)

        RUN TYPE                 MEAN          STD DEV   COEF OF SKEW     COEF OF VAR

      TRAMPLING1                 6.39              .45          -.475            .071
      TRAMPLING2                 6.59              .45          -.812            .069
      TRAMPLING3                 6.57              .47           .121            .072
      TRAMPLING4                 6.56              .43          -.376            .065

   ALL TRAMPLING               6.5281            .0905          N=  4
```

Table C.57. Statistics by Trampling Level.

```
DURATION OF RUNOFF (MINUTES)
        RUN TYPE              MEAN         STD DEV    COEF OF SKEW     COEF OF VAR
      TRAMPLING1             31.03             .87            .150            .028
      TRAMPLING2             30.91             .92            .345            .030
      TRAMPLING3             30.78             .96            .552            .031
      TRAMPLING4             30.45             .68           1.534            .022

   ALL TRAMPLING           30.7927           .2500         N=   4
```

Table C.58. Statistics by Trampling Level.

```
START OF RUNOFF (MINUTES)
        RUN TYPE              MEAN         STD DEV    COEF OF SKEW     COEF OF VAR
      TRAMPLING1              1.59             .99           2.133            .621
      TRAMPLING2              1.68            1.03           1.069            .616
      TRAMPLING3              2.48            1.80           1.086            .725
      TRAMPLING4              3.03            2.23           1.107            .736

   ALL TRAMPLING            2.1960           .6883         N=   4
```

Table C.59. Statistics by Trampling Level.

```
END OF RUNOFF (MINUTES)
        RUN TYPE              MEAN         STD DEV    COEF OF SKEW     COEF OF VAR
      TRAMPLING1             31.57             .86            .126            .027
      TRAMPLING2             31.44             .89            .305            .028
      TRAMPLING3             31.42            1.08            .536            .034
      TRAMPLING4             31.05             .72           1.227            .023

   ALL TRAMPLING           31.3719           .2219         N=   4
```

Table C.60. Statistics by Trampling Level.

```
INFILTRATION RATE (IN/HR)
          RUN TYPE               MEAN          STD DEV    COEF OF SKEW     COEF OF VAR

       TRAMPLING1                 .67             .25         -.076           .372
       TRAMPLING2                 .74             .24         -.078           .319
       TRAMPLING3                 .84             .31          .361           .364
       TRAMPLING4                 .96             .36          .177           .377

    ALL TRAMPLING               .8019           .1266         N=  4
```

APPENDIX D

CHARACTERISTIC STATISTICS FOR RESOURCE CHARACTERIZATION DATA

Table D.1. Statistics By Plot Type.

VEGETATION COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	0.0	.01	1.04	R
M1	15.5	4.94	.79	.32
N1	18.5	7.16	.69	.39
B2	0.0	.01	1.04	R
M2	13.5	3.96	.35	.29
N2	16.9	7.62	.67	.45
B3	0.0	.01	1.04	R
M3	13.5	6.44	.79	.48
N3	13.8	4.86	.98	.35
B4	0.0	.01	1.04	R
M4	10.5	6.38	1.23	.61
N4	12.3	5.59	.93	.46
ALL RUNS	9.5444	7.3376	N= 12	

Table D.2. Statistics By Plot Type.

LITTER COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	8.3	6.44	.80	.77
M1	12.9	5.60	.40	.43
N1	12.0	6.16	.77	.51
B2	5.5	4.39	.82	.80
M2	8.7	3.79	.22	.44
N2	11.5	5.96	1.24	.52
B3	3.5	2.26	.82	.64
M3	11.5	6.94	2.06	.60
N3	13.0	9.89	2.21	.76
B4	1.6	1.06	.11	.66
M4	8.5	5.05	1.16	.59
N4	10.1	5.04	.29	.50
ALL RUNS	8.9333	3.7186	N= 12	

Table D.3. Statistics By Plot Type.

ROCK COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	5.3	3.92	1.82	.74
M1	3.1	1.91	.89	.62
N1	3.1	2.39	.71	.76
B2	3.1	2.42	1.14	.77
M2	3.3	2.06	.20	.62
N2	2.4	1.80	-.02	.75
B3	2.3	2.09	.73	.92
M3	2.0	2.42	1.78	1.21
N3	2.3	2.28	.88	1.01
B4	3.1	2.61	.77	.83
M4	1.8	1.90	1.45	1.05
N4	.7	.88	.56	1.21
ALL RUNS	2.7111	1.1004	N= 12	

Table D.4. Statistics By Plot Type.

TOTAL COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	13.6	6.47	.37	.48
M1	31.5	8.34	1.16	.26
N1	33.6	9.57	.18	.28
B2	8.6	5.11	.53	.59
M2	25.5	6.66	.28	.26
N2	30.9	12.25	.95	.40
B3	5.8	3.36	.56	.58
M3	27.0	12.47	1.85	.46
N3	29.1	13.53	1.56	.47
B4	4.7	2.81	.62	.59
M4	20.9	9.49	1.22	.45
N4	23.1	7.21	.25	.31
ALL RUNS	21.1889	10.4289	N= 12	

Table D.5. Statistics By Plot Type.

% BARE (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	86.4	6.47	-.37	.07
M1	68.5	8.34	-1.16	.12
N1	66.4	9.57	-.18	.14
B2	91.4	5.11	-.53	.06
M2	74.5	6.66	-.28	.09
N2	69.1	12.25	-.95	.18
B3	94.2	3.36	-.56	.04
M3	73.0	12.47	-1.85	.17
N3	70.9	13.53	-1.56	.19
B4	95.3	2.81	-.62	.03
M4	79.2	9.47	-1.24	.12
N4	76.9	7.21	-.25	.09
ALL RUNS	78.8167	10.4291	N= 12	

Table D.6. Statistics By Plot Type.

% DISTURBED (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	0.0	.01	1.04	R
M1	0.0	.01	1.04	R
N1	0.0	.01	1.04	R
B2	8.7	3.09	-.01	.36
M2	7.1	3.52	.97	.49
N2	8.1	3.14	.33	.39
B3	36.9	5.25	.35	.14
M3	31.1	7.58	-.01	.24
N3	32.1	7.61	.65	.24
B4	60.5	6.03	.49	.10
M4	57.7	10.50	.90	.18
N4	54.5	5.85	.05	.11
ALL RUNS	24.7222	23.6921	N= 12	

Table D.7. Statistics By Plot Type.

VEGETATION COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	0.0	.01	1.04	R
M1	16.7	4.77	.70	.29
N1	19.6	8.45	.85	.43
B2	0.0	.01	1.04	R
M2	13.9	4.47	.25	.32
N2	18.9	8.89	.81	.47
B3	0.0	.01	1.04	R
M3	14.6	6.23	.73	.43
N3	16.0	5.10	.78	.32
B4	0.0	.01	1.04	R
M4	11.5	6.01	1.21	.52
N4	13.8	6.63	1.12	.48
ALL RUNS	10.4133	7.9990	N= 12	

Table D.8. Statistics By Plot Type.

LITTER COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	9.0	6.76	.96	.75
M1	12.1	4.44	1.05	.37
N1	11.8	5.83	1.41	.50
B2	5.8	4.29	1.39	.74
M2	10.0	4.14	.25	.42
N2	12.4	6.01	1.09	.48
B3	4.4	1.82	.30	.41
M3	12.6	6.97	2.08	.55
N3	14.1	8.05	2.03	.57
B4	2.9	1.17	1.04	.40
M4	9.8	4.79	.76	.49
N4	10.9	4.76	.92	.44
ALL RUNS	9.6478	3.5117	N= 12	

Table D.9. Statistics By Plot Type.

ROCK COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	6.2	3.57	1.54	.58
M1	4.2	1.74	.89	.42
N1	4.3	2.17	1.05	.51
B2	4.5	2.63	1.44	.59
M2	4.1	1.36	.30	.33
N2	3.2	1.34	.61	.42
B3	3.7	2.25	2.30	.60
M3	3.4	2.05	1.27	.59
N3	3.8	2.09	.40	.55
B4	4.5	2.62	1.31	.58
M4	3.0	2.14	2.30	.71
N4	2.8	1.29	.45	.45
ALL RUNS	3.9789	.8980	N= 12	

Table D.10. Statistics By Plot Type.

TOTAL COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	15.2	6.49	.22	.43
M1	33.0	7.71	1.01	.23
N1	35.7	10.77	.23	.30
B2	10.3	4.54	.43	.44
M2	27.9	6.93	.15	.25
N2	34.5	13.53	.71	.39
B3	8.1	3.29	1.18	.41
M3	30.6	12.25	1.58	.40
N3	33.8	11.17	1.33	.33
B4	7.5	3.18	.92	.43
M4	24.3	8.97	1.35	.37
N4	27.6	8.22	.63	.30
ALL RUNS	24.0400	10.8185	N= 12	

Table D.11. Statistics By Plot Type.

% BARE (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	84.8	6.49	-.22	.08
M1	67.0	7.71	-1.01	.11
N1	64.4	10.94	-.17	.17
B2	89.7	4.54	-.43	.05
M2	72.1	6.93	-.15	.10
N2	65.6	13.67	-.69	.21
B3	91.9	3.29	-1.18	.04
M3	69.5	11.10	-1.29	.16
N3	66.2	11.17	-1.33	.17
B4	92.5	3.18	-.92	.03
M4	76.0	7.23	-1.14	.10
N4	72.4	8.22	-.63	.11
ALL RUNS	76.0067	10.7935	N= 12	

Table D.12. Statistics By Plot Type.

% DISTURBED (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	0.0	.01	1.04	R
M1	0.0	.01	1.04	R
N1	0.0	.01	1.04	R
B2	8.5	2.91	.27	.34
M2	7.6	3.53	.84	.47
N2	8.5	3.23	.14	.38
B3	38.8	6.30	.32	.16
M3	31.4	7.16	.23	.23
N3	33.9	8.08	.06	.24
B4	63.5	5.68	.16	.09
M4	61.3	9.80	.68	.16
N4	57.7	6.27	.01	.11
ALL RUNS	25.9261	25.0306	N= 12	

Table D.13. Statistics By Plot Type.

PLANT DIAMETER (INCHES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	0.0	.01	1.04	R
M1	15.6	3.11	1.24	.20
N1	16.9	3.73	.47	.22
B2	0.0	.01	1.04	R
M2	13.5	2.61	.25	.19
N2	17.5	6.09	1.05	.35
B3	0.0	.01	1.04	R
M3	13.8	3.12	.65	.23
N3	15.1	2.96	.59	.20
B4	0.0	.01	1.04	R
M4	12.6	4.04	1.68	.32
N4	14.5	2.60	.55	.18
ALL RUNS	9.9522	7.4708	N= 12	

Table D.14. Statistics By Plot Type.

PLANT HEIGHT (INCHES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	0.0	.01	1.04	R
M1	4.8	.87	-.37	.18
N1	6.4	1.48	-.10	.23
B2	0.0	.01	1.04	R
M2	4.4	.75	.33	.17
N2	6.6	1.87	.56	.28
B3	0.0	.01	1.04	R
M3	4.4	.63	.91	.14
N3	6.3	.83	.31	.13
B4	0.0	.01	1.04	R
M4	4.2	1.35	1.75	.32
N4	5.5	1.38	.82	.25
ALL RUNS	3.5350	2.7306	N= 12	

Table D.15. Statistics By Replication.

```
VEGETATION COVER IN % (POINT METHOD)
   RUN TYPE                MEAN          STD DEV   COEF OF SKEW    COEF OF VAR

       REP  1              10.5             9.14            .17            .87
       REP  2               6.3             5.60            .23            .88
       REP  3              10.8             9.82            .37            .91
       REP  4               9.3             8.81            .59            .95
       REP  5               9.1             7.72          -.03             .85
       REP  6              10.6             9.26            .01            .87
       REP  7              11.3            10.73            .65            .95
       REP  8               8.4             8.81            .86           1.05
       REP  9               8.3             9.18           1.67           1.11
       REP10               11.7             9.77          -.03             .84
       REP11                8.9             7.62            .04            .85
       REP12                8.8             7.88            .18            .89
       REP13                9.7             7.32          -.58             .76
       REP14               10.2             9.08            .40            .89
       REP15                9.4             8.99            .64            .95

   ALL  REPS            9.5444          1.3634          N=  15
```

Table D.16. Statistics By Replication.

```
LITTER COVER IN % (POINT METHOD)
   RUN TYPE                MEAN          STD DEV   COEF OF SKEW    COEF OF VAR

       REP  1               9.1             5.58           1.13            .61
       REP  2               8.8             4.99          -.13             .56
       REP  3              11.2             9.03           1.23            .81
       REP  4              10.5             6.24            .29            .59
       REP  5               9.6             6.07            .17            .63
       REP  6              10.4             7.49            .39            .72
       REP  7               7.8             4.51          -.43             .58
       REP  8               8.6             7.01           1.05            .82
       REP  9               8.3             6.98           1.35            .85
       REP10               12.8            11.35           1.92            .89
       REP11                6.8             4.25            .19            .63
       REP12                7.3             4.50          -.25             .61
       REP13                6.3             4.74            .14            .75
       REP14                8.3             4.67            .33            .57
       REP15                8.3             7.13           1.32            .86

   ALL  REPS            8.9333          1.7192          N=  15
```

Table D.17. Statistics By Replication.

ROCK COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	2.8	2.72	.93	.96
REP 2	2.5	2.47	1.58	.99
REP 3	3.1	2.35	.67	.76
REP 4	2.8	2.38	.63	.87
REP 5	2.8	2.45	1.16	.89
REP 6	4.0	2.70	.21	.67
REP 7	1.2	.83	.70	.72
REP 8	2.2	2.44	.61	1.13
REP 9	1.7	1.72	1.38	1.03
REP10	2.2	1.99	.65	.92
REP11	3.3	2.31	.47	.69
REP12	3.7	2.50	.03	.68
REP13	2.3	1.22	-.85	.54
REP14	2.3	2.46	.82	1.06
REP15	4.0	4.43	2.37	1.11
ALL REPS	2.7111	.8128	N= 15	

Table D.18. Statistics By Replication.

TOTAL COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	22.4	11.99	-.25	.53
REP 2	17.7	9.89	.02	.56
REP 3	25.0	17.03	1.16	.68
REP 4	22.5	14.84	.50	.66
REP 5	21.4	11.74	-.33	.55
REP 6	25.0	15.92	.19	.64
REP 7	20.3	13.31	-.11	.65
REP 8	19.2	14.85	.88	.77
REP 9	18.2	13.81	1.79	.76
REP10	26.6	16.99	.89	.64
REP11	19.0	9.34	-.47	.49
REP12	19.8	11.59	-.02	.58
REP13	18.3	10.22	-.49	.56
REP14	20.8	11.66	.29	.56
REP15	21.8	14.54	.59	.67
ALL REPS	21.1889	2.7198	N= 15	

Table D.19. Statistics By Replication.

% BARE (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEFF OF SKEW	COEFF OF VAR
REP 1	77.6	11.99	.25	.15
REP 2	82.3	9.89	-.02	.12
REP 3	75.0	17.03	-1.16	.23
REP 4	77.5	14.84	-.50	.19
REP 5	78.6	11.74	.33	.15
REP 6	75.0	15.92	-.19	.21
REP 7	79.8	13.29	.09	.17
REP 8	80.8	14.85	-.88	.18
REP 9	81.8	13.81	-1.79	.17
REP10	73.4	16.99	-.89	.23
REP11	81.0	9.34	.47	.12
REP12	80.2	11.59	.02	.14
REP13	81.8	10.22	.49	.12
REP14	79.3	11.66	-.29	.15
REP15	78.3	14.54	-.59	.19
ALL REPS	78.8167	2.7218	N= 15	

Table D.20. Statistics By Replication.

% DISTURBED (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEFF OF SKEW	COEFF OF VAR
REP 1	26.8	25.03	.33	.94
REP 2	25.5	23.90	.41	.94
REP 3	26.6	23.99	.14	.90
REP 4	25.4	25.05	.32	.99
REP 5	24.2	22.29	.23	.92
REP 6	24.3	22.42	.40	.92
REP 7	26.8	27.71	.60	1.03
REP 8	25.1	26.91	.61	1.07
REP 9	23.2	22.40	.42	.97
REP10	23.1	24.64	.59	1.07
REP11	22.3	23.22	.75	1.04
REP12	22.9	21.33	.27	.93
REP13	25.3	24.73	.40	.98
REP14	26.3	27.13	.73	1.03
REP15	23.1	22.20	.46	.96
ALL REPS	24.7222	1.5432	N= 15	

Table D.21. Statistics By Replication.

VEGETATION COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	10.8	9.68	.48	.90
REP 2	7.1	6.31	.20	.89
REP 3	10.9	10.08	.40	.92
REP 4	10.6	9.49	.35	.90
REP 5	10.6	8.54	-.20	.81
REP 6	11.9	10.28	.02	.87
REP 7	12.5	11.71	.73	.94
REP 8	9.0	9.15	.74	1.02
REP 9	8.4	9.75	1.96	1.17
REP10	12.4	10.21	-.09	.83
REP11	9.9	7.90	-.25	.80
REP12	9.1	8.13	.18	.90
REP13	10.9	8.52	-.37	.78
REP14	11.2	10.65	.57	.95
REP15	11.1	10.84	.88	.97
ALL REPS	10.4133	1.4958	N= 15	

Table D.22. Statistics By Replication.

LITTER COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	8.7	3.74	.97	.43
REP 2	9.1	5.10	.01	.56
REP 3	11.4	8.63	1.58	.76
REP 4	10.7	5.20	.18	.49
REP 5	11.4	5.82	.00	.51
REP 6	11.4	7.34	.72	.65
REP 7	8.9	4.41	-.70	.50
REP 8	9.2	6.36	.99	.69
REP 9	10.1	6.48	1.25	.65
REP10	12.7	10.44	1.42	.82
REP11	7.1	4.38	.54	.62
REP12	7.7	4.10	-.50	.53
REP13	7.9	5.38	.50	.69
REP14	8.9	4.00	.83	.45
REP15	9.8	7.12	1.40	.72
ALL REPS	9.6478	1.6017	N= 15	

Table D.23. Statistics By Replication.

ROCK COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	3.9	2.39	1.26	.62
REP 2	3.8	1.14	.93	.30
REP 3	3.6	2.40	1.50	.67
REP 4	4.5	1.78	.30	.40
REP 5	3.7	2.49	2.04	.67
REP 6	4.6	3.01	.83	.65
REP 7	2.6	1.32	.35	.50
REP 8	3.4	2.01	1.40	.59
REP 9	2.9	1.53	.78	.53
REP10	3.1	1.50	-.04	.48
REP11	4.3	2.55	1.79	.59
REP12	5.0	2.44	.65	.49
REP13	3.6	1.28	.32	.35
REP14	5.1	2.43	1.21	.47
REP15	5.5	3.63	2.47	.66
ALL REPS	3.9789	.8420	N= 15	

Table D.24. Statistics By Replication.

TOTAL COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	23.3	11.60	.04	.50
REP 2	20.0	11.12	.02	.56
REP 3	25.9	15.50	1.40	.60
REP 4	25.7	13.99	.25	.54
REP 5	25.7	11.59	-.35	.45
REP 6	27.8	16.22	.11	.58
REP 7	24.0	13.78	-.00	.57
REP 8	21.6	14.99	.58	.69
REP 9	21.3	13.81	1.53	.65
REP10	28.2	17.39	.67	.62
REP11	21.3	9.95	-.69	.47
REP12	21.7	11.70	.16	.54
REP13	22.4	12.60	.12	.56
REP14	25.2	12.24	.33	.49
REP15	26.5	16.46	.60	.62
ALL REPS	24.0400	2.5913	N= 15	

Table D.25. Statistics By Replication.

% BARE (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEFF OF SKEW	COEFF OF VAR
REP 1	76.7	11.59	-.04	.15
REP 2	80.0	11.12	-.02	.14
REP 3	74.6	14.31	-1.17	.19
REP 4	74.3	13.99	-.25	.19
REP 5	74.3	11.59	.35	.16
REP 6	72.2	16.22	-.11	.22
REP 7	76.4	13.81	-.09	.18
REP 8	77.7	14.74	-.48	.19
REP 9	78.9	13.81	-1.57	.18
REP10	72.3	16.77	-.72	.23
REP11	78.4	10.10	.74	.13
REP12	78.3	11.70	-.16	.15
REP13	77.8	12.61	-.16	.16
REP14	74.8	12.24	-.33	.16
REP15	73.5	16.46	-.60	.22
ALL REPS	76.0067	2.4772	N= 15	

Table D.26. Statistics By Replication.

% DISTURBED (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEFF OF SKEW	COEFF OF VAR
REP 1	28.0	25.92	.34	.93
REP 2	26.9	25.66	.38	.95
REP 3	28.0	25.56	.20	.91
REP 4	25.5	25.55	.45	1.00
REP 5	25.2	23.38	.26	.93
REP 6	24.8	23.75	.47	.96
REP 7	28.0	29.25	.56	1.04
REP 8	26.4	28.16	.58	1.07
REP 9	24.3	24.21	.46	1.00
REP10	24.2	26.12	.60	1.08
REP11	23.7	24.47	.66	1.03
REP12	24.1	21.87	.24	.91
REP13	27.3	26.34	.34	.97
REP14	27.4	28.36	.69	1.04
REP15	25.2	23.94	.47	.95
ALL REPS	25.9261	1.5743	N= 15	

Table D.27. Statistics By Replication.

PLANT DIAMETER (INCHES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	9.8	7.87	-.25	.80
REP 2	8.1	6.37	-.41	.78
REP 3	10.0	7.90	-.32	.79
REP 4	11.0	8.85	-.19	.81
REP 5	10.1	7.75	-.45	.77
REP 6	10.7	8.93	.05	.84
REP 7	10.7	8.36	-.30	.78
REP 8	9.4	7.81	-.03	.83
REP 9	9.0	8.73	1.18	.97
REP10	11.6	9.04	-.39	.78
REP11	10.0	7.63	-.52	.77
REP12	9.3	7.16	-.47	.77
REP13	9.6	7.15	-.66	.75
REP14	9.9	7.80	-.36	.79
REP15	10.2	8.49	.07	.83
ALL REPS	9.9522	.8443	N= 15	

Table D.28. Statistics By Replication.

PLANT HEIGHT (INCHES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	3.5	3.04	.18	.86
REP 2	3.1	2.44	-.40	.78
REP 3	3.3	2.64	-.23	.81
REP 4	3.6	2.90	-.24	.80
REP 5	3.4	2.81	-.07	.83
REP 6	3.9	3.34	.17	.85
REP 7	3.7	2.98	-.21	.80
REP 8	3.3	2.77	-.01	.83
REP 9	3.7	3.19	.30	.87
REP10	3.7	2.95	-.19	.81
REP11	3.4	2.68	-.39	.78
REP12	3.4	2.74	-.22	.81
REP13	3.2	2.56	-.29	.80
REP14	3.6	2.91	-.12	.81
REP15	4.1	3.29	-.32	.79
ALL REPS	3.5350	.2692	N= 15	

Table D.29. Statistics By Trampling Level.

VEGETATION COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	11.3	9.55	.24	.84
TRAMPLING2	10.1	8.83	.42	.87
TRAMPLING3	9.1	7.95	.37	.87
TRAMPLING4	7.6	7.28	.77	.96
ALL TRAMPLING	9.5444	1.5828	N= 4	

Table D.30. Statistics By Trampling Level.

LITTER COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	11.1	6.27	.47	.57
TRAMPLING2	8.6	5.32	1.00	.62
TRAMPLING3	9.3	8.10	2.32	.87
TRAMPLING4	6.8	5.53	.87	.82
ALL TRAMPLING	8.9333	1.7974	N= 4	

Table D.31. Statistics By Trampling Level.

ROCK COVER IN % (POINT METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	3.8	2.99	2.02	.78
TRAMPLING2	3.0	2.10	.66	.71
TRAMPLING3	2.2	2.22	1.16	1.02
TRAMPLING4	1.9	2.13	1.50	1.13
ALL TRAMPLING	2.7111	.8670	N= 4	

Table D.32. Statistics By Trampling Level.

```
TOTAL COVER IN % (POINT METHOD)
     RUN TYPE              MEAN        STD DEV   COEF OF SKEW     COEF OF VAR

   TRAMPLING1              26.2         12.13            .15              .46
   TRAMPLING2              21.6         12.73            .62              .59
   TRAMPLING3              20.6         14.98           1.12              .73
   TRAMPLING4              16.2         10.79            .50              .66

 ALL TRAMPLING           21.1889        4.1043          N=  4
```

Table D.33. Statistics By Trampling Level.

```
% BARE (POINT METHOD)
     RUN TYPE              MEAN        STD DEV   COEF OF SKEW     COEF OF VAR

   TRAMPLING1              73.8         12.13           -.15              .16
   TRAMPLING2              78.4         12.73           -.62              .16
   TRAMPLING3              79.4         14.98          -1.12              .19
   TRAMPLING4              83.8         10.77           -.51              .13

 ALL TRAMPLING           78.8167        4.1132          N=  4
```

Table D.34. Statistics By Trampling Level.

```
% DISTURBED (POINT METHOD)
     RUN TYPE              MEAN        STD DEV   COEF OF SKEW     COEF OF VAR

   TRAMPLING1               0.0           .01           1.01                R
   TRAMPLING2               8.0          3.24            .40              .41
   TRAMPLING3              33.3          7.21            .02              .22
   TRAMPLING4              57.6          7.99            .72              .14

 ALL TRAMPLING           24.7222       26.1100          N=  4
```

Table D.35. Statistics By Trampling Level.

VEGETATION COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	12.1	10.32	.33	.85
TRAMPLING2	10.9	9.85	.62	.90
TRAMPLING3	10.2	8.59	.20	.84
TRAMPLING4	8.4	7.92	.75	.94
ALL TRAMPLING	10.4133	1.5468	N= 4	

Table D.36. Statistics By Trampling Level.

LITTER COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	10.9	5.80	.83	.53
TRAMPLING2	9.4	5.51	.93	.59
TRAMPLING3	10.4	7.46	1.94	.72
TRAMPLING4	7.9	5.26	.89	.67
ALL TRAMPLING	9.6478	1.3352	N= 4	

Table D.37. Statistics By Trampling Level.

ROCK COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	4.9	2.72	1.89	.56
TRAMPLING2	3.9	1.91	1.62	.49
TRAMPLING3	3.7	2.09	1.37	.57
TRAMPLING4	3.5	2.18	1.81	.63
ALL TRAMPLING	3.9789	.6330	N= 4	

Table D.38. Statistics By Trampling Level.

TOTAL COVER IN % (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	27.9	12.41	.19	.44
TRAMPLING2	24.3	13.68	.68	.56
TRAMPLING3	24.2	14.99	.70	.62
TRAMPLING4	19.8	11.38	.48	.58
ALL TRAMPLING	24.0400	3.3415	N= 4	

Table D.39. Statistics By Trampling Level.

% BARE (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	72.1	12.44	-.20	.17
TRAMPLING2	75.8	13.69	-.69	.18
TRAMPLING3	75.8	14.69	-.59	.19
TRAMPLING4	80.3	10.95	-.33	.14
ALL TRAMPLING	76.0067	3.3657	N= 4	

Table D.40. Statistics By Trampling Level.

% DISTURBED (CELL METHOD)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	0.0	.01	1.01	R
TRAMPLING2	8.2	3.18	.40	.39
TRAMPLING3	34.7	7.71	.03	.22
TRAMPLING4	60.8	7.70	.45	.13
ALL TRAMPLING	25.9261	27.5786	N= 4	

Table D.41. Statistics By Trampling Level.

PLANT DIAMETER (INCHES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	10.8	8.22	-.33	.76
TRAMPLING2	10.3	8.45	.18	.82
TRAMPLING3	9.6	7.31	-.34	.76
TRAMPLING4	9.0	7.05	-.16	.78
ALL TRAMPLING	9.9522	.7868	N= 4	

Table D.42. Statistics By Trampling Level.

PLANT HEIGHT (INCHES)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	3.7	2.91	-.20	.78
TRAMPLING2	3.7	2.99	.14	.82
TRAMPLING3	3.5	2.71	-.31	.77
TRAMPLING4	3.2	2.60	.04	.81
ALL TRAMPLING	3.5350	.2271	N= 4	

APPENDIX E

CHARACTERISTIC STATISTICS
FOR SOIL MOISTURE DATA

Table E.1. Statistics By Plot Type.

SOIL MOISTURE (PERCENT)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	18.16	1.63	.55	.09
B2	17.86	1.11	.35	.06
B3	18.44	1.17	-.12	.06
B4	17.95	1.47	-.84	.08
M1	17.98	1.54	-.14	.09
M2	18.33	2.12	-.13	.12
M3	18.09	1.85	-.06	.10
M4	19.19	1.36	-.35	.07
N1	17.51	1.23	-.49	.07
N2	17.60	1.01	-.99	.06
N3	17.41	1.33	.15	.08
N4	18.40	1.08	.18	.06
All Plots	18.08	0.49	N = 12	

Table E.2. Statistics By Replication.

SOIL MOISTURE (PERCENT)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP1	18.18	1.55	.98	.09
REP2	18.62	1.44	1.51	.08
REP3	17.66	1.03	1.10	.06
REP4	19.38	1.55	-.49	.08
REP5	18.36	1.06	.74	.06
REP6	18.30	1.60	.74	.09
REP7	17.57	1.37	-.30	.08
REP8	18.27	1.54	.79	.08
REP9	18.59	1.23	-.71	.07
REP10	17.73	.88	-.50	.05
REP11	16.80	1.71	-.12	.10
REP12	16.53	1.35	.45	.08
REP13	18.15	.98	.58	.05
REP14	18.55	1.51	.33	.08
REP15	18.50	1.10	.62	.06
All Replications	18.08	0.73	N = 15	

Table E.3. Statistics by Trampling Level.

SOIL MOISTURE (PERCENT)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	17.88	1.47	.21	.08
TRAMPLING2	17.93	1.50	.24	.08
TRAMPLING3	17.98	1.51	-.03	.08
TRAMPLING4	18.51	1.38	-.40	.07
All Trampling	18.08	0.29	N = 4	

APPENDIX F

CHARACTERISTIC STATISTICS FOR SEDIMENT CONCENTRATION DATA

Table F.1. Statistics By Run Type.

SEDIMENT CONCENTRATION (PPM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	8563.	2210.	.37	.26
B1W	7003.	2616.	1.19	.37
M1D	8077.	2069.	-.45	.26
M1W	6080.	1976.	.27	.33
N1D	7475.	1324.	.21	.18
N1W	5981.	1202.	-.39	.20
B2D	9619.	1700.	-.11	.18
B2W	7276.	1950.	.10	.27
M2D	9274.	1849.	.26	.20
M2W	7306.	1896.	-.48	.26
N2D	8778.	1940.	.38	.22
N2W	6820.	2080.	.31	.30
B3D	11225.	2216.	1.63	.20
B3W	7876.	2589.	1.84	.33
M3D	9403.	2288.	.39	.24
M3W	6651.	2224.	.43	.33
N3D	9575.	1839.	1.00	.19
N3W	7106.	2008.	1.95	.28
B4D	11045.	1210.	-.22	.11
B4W	7728.	1418.	.70	.18
M4D	11811.	2006.	.10	.17
M4W	8229.	1613.	-.12	.20
N4D	9499.	3080.	-.81	.32
N4W	7629.	1729.	.96	.23
Dry Runs	9529.	1181.	N = 4	
Wet Runs	7141.	617.	N = 4	

Table F.2. Statistics By Plot Type.

SEDIMENT CONCENTRATION (PPM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	7783.	2508.	.60	.32
M1	7079.	2232.	-.03	.32
N1	6728.	1456.	.08	.22
B2	8448.	2156.	-.15	.26
M2	8290.	2095.	-.11	.25
N2	7799.	2213.	.16	.28
B3	9551.	2917.	.75	.31
M3	8027.	2622.	.28	.33
N3	8340.	2271.	.78	.27
B4	9386.	2127.	-.06	.23
M4	10020.	2553.	.24	.25
N4	8564.	2632.	.02	.31
All Runs	8335.	969.	N = 12	

Table F.3. Statistics By Replication.

SEDIMENT CONCENTRATION (PPM)

RUN TYPE	MEAN	STD DEV	COEFF OF SKEW	COEFF OF VAR
REP 1	7974.	2148.	-.80	.27
REP 2	9189.	3039.	.16	.33
REP 3	7954.	2725.	.25	.34
REP 4	7508.	2322.	.37	.31
REP 5	8041.	2294.	.24	.29
REP 6	9158.	2694.	.26	.29
REP 7	8635.	2125.	.25	.25
REP 8	7407.	1798.	.39	.24
REP 9	9830.	2344.	.31	.24
REP10	7407.	2279.	.63	.31
REP11	7696.	2658.	.08	.35
REP12	8911.	1874.	.07	.21
REP13	7957.	2320.	1.03	.29
REP14	8360.	2469.	.06	.30
REP15	8990.	2943.	1.18	.33
All Reps	8339.	742.	N = 15	

Table F.4. Statistics By Trampling Level.

SEDIMENT CONCENTRATION (PPM)

RUN TYPE	MEAN	STD DEV	COEFF OF SKEW	COEFF OF VAR
TRAMPLING1	7197.	2135.	.53	.30
TRAMPLING2	8179.	2149.	-.04	.26
TRAMPLING3	8639.	2670.	.66	.31
TRAMPLING4	9324.	2493.	.05	.27
All Trampling	8335.	893.	N = 4	

APPENDIX G

CHARACTERISTIC STATISTICS FOR CHEMICAL DATA

Table G.1. Laboratory Electric Conductivity Statistics by Run Type.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)
         RUN TYPE              MEAN              STD DEV    COEF OF SKEW     COEF OF VAR

              B1D             344.7               166.9               .6             .48
              B1W             327.9               184.2               .8             .56
              M1D             373.1               181.7              1.2             .49
              M1W             324.5               172.8              1.0             .53
              N1D             338.0               128.4              1.1             .38
              N1W             291.8               190.0              1.5             .65
              B2D             504.3               321.1               .7             .64
              B2W             411.2               253.2               .6             .62
              M2D             496.2               228.3               .5             .46
              M2W             427.7               290.1               .8             .68
              N2D             382.8               221.1              1.0             .58
              N2W             302.0               164.3              1.0             .54
              B3D             681.6               428.9               .6             .63
              B3W             561.7               370.0               .5             .66
              M3D             392.0               232.3               .8             .59
              M3W             313.1               193.7              1.0             .62
              N3D             512.7               321.8              1.1             .63
              N3W             398.1               278.7              1.3             .70
              B4D             421.7               224.5               .9             .53
              B4W             438.7               236.0               .1             .54
              M4D             787.0               420.6               .2             .53
              M4W             630.0               320.1               .4             .51
              N4D             586.1               337.0              1.4             .57
              N4W             467.0               292.8               .9             .63

         DRY RUNS          485.0111            140.8598            N= 12

         WET RUNS          407.8000            106.5791            N= 12
```

Table G.2. Laboratory pH Statistics by Run Type.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	7.9	.5	.2	.06
B1W	8.0	.5	-.8	.06
M1D	7.9	.3	-.5	.04
M1W	7.9	.5	.3	.06
N1D	8.3	.4	-.4	.05
N1W	8.2	.6	-.4	.07
B2D	7.6	.5	1.3	.07
B2W	7.6	.3	1.2	.04
M2D	7.5	.4	.7	.05
M2W	7.5	.4	2.1	.06
N2D	7.7	.5	.1	.07
N2W	7.8	.5	.6	.06
B3D	8.0	.4	-.0	.05
B3W	7.9	.6	.6	.07
M3D	7.9	.6	.3	.08
M3W	8.1	.7	-.0	.08
N3D	7.9	.4	-.1	.05
N3W	7.9	.6	.1	.08
B4D	8.1	.4	.8	.05
B4W	7.9	.6	.7	.08
M4D	8.4	.7	1.2	.09
M4W	8.2	.7	1.0	.08
N4D	8.2	.5	.1	.06
N4W	8.1	.5	-.8	.06
DRY RUNS	7.9383	.2585	N= 12	
WET RUNS	7.9161	.2334	N= 12	

Table G.3. Statistics by Run Type.

TOTAL ALKALINITY AS CACO3 (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	15.2407	1.4845	.3826	.0974
B1W	14.1960	1.7750	.7056	.1250
M1D	18.4593	2.4335	.8900	.1318
M1W	16.6693	3.0814	1.1022	.1849
N1D	18.8413	3.2399	.2767	.1720
N1W	17.6360	3.0332	.1799	.1720
B2D	15.3980	2.3797	1.0480	.1545
B2W	15.0520	2.7254	.5052	.1811
M2D	17.8040	3.6878	1.5899	.2071
M2W	15.6533	2.9421	1.7555	.1880
N2D	19.6213	5.2153	.6171	.2658
N2W	18.2353	3.6953	.9200	.2026
B3D	18.6593	5.6313	1.2925	.3018
B3W	15.9013	5.0981	1.6292	.3206
M3D	19.3233	2.4258	.0077	.1255
M3W	17.5927	3.3834	.5613	.1923
N3D	20.1053	3.5043	.2379	.1743
N3W	17.1480	3.5261	-.3378	.2056
B4D	18.8193	5.4117	2.2316	.2876
B4W	14.7907	2.0700	1.2380	.1400
M4D	18.8493	3.0645	.3205	.1626
M4W	17.5347	3.7013	1.1104	.2111
N4D	18.7380	1.8416	.2547	.0983
N4W	18.1000	3.5645	1.4563	.1969
DRY RUNS	18.2560	1.4711	N= 12	
WET RUNS	16.5424	1.3802	N= 12	

Table G.4. Statistics by Run Type.

TOTAL DISSOLVED SOLIDS (G/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	.2563	.1248	.6556	.4869
B1W	.2424	.1371	.9200	.5654
M1D	.2791	.1629	1.0811	.5835
M1W	.2305	.1243	.7231	.5395
N1D	.2673	.1295	1.1806	.4845
N1W	.2339	.1666	1.1374	.7123
B2D	.4288	.3768	1.2307	.8787
B2W	.2777	.1904	.5440	.6855
M2D	.3690	.1824	.4700	.4943
M2W	.3234	.2600	1.0575	.8040
N2D	.2855	.2006	.9160	.7025
N2W	.2112	.1360	1.7489	.6440
B3D	.6987	.7217	2.1504	1.0330
B3W	.4701	.3203	.4511	.6812
M3D	.3003	.1811	.8362	.6029
M3W	.2414	.1652	.9820	.6845
N3D	.3859	.2910	1.3588	.7542
N3W	.3523	.2623	1.1592	.7445
B4D	.3619	.2305	.9935	.6371
B4W	.3366	.1981	.4956	.5886
M4D	.6597	.4102	.3333	.6218
M4W	.5199	.3046	.3428	.5858
N4D	.4263	.2203	.6849	.5168
N4W	.3695	.2513	1.0149	.6801
DRY RUNS	.3932	.1465	N= 12	
WET RUNS	.3174	.0988	N= 12	

Table G.5. Statistics by Run Type.

FLOURIDE,F- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	.14	.04	.715	.310
B1W	.16	.06	.607	.375
M1D	.15	.05	.148	.309
M1W	.12	.04	.871	.355
N1D	.17	.04	.111	.239
N1W	.19	.18	2.930	.925
B2D	.16	.04	.695	.245
B2W	.11	.03	.250	.252
M2D	.17	.08	1.076	.446
M2W	.19	.17	2.726	.875
N2D	.23	.18	2.735	.760
N2W	.18	.07	.923	.419
B3D	.33	.34	1.454	1.032
B3W	.25	.26	2.046	1.009
M3D	.17	.04	-.927	.235
M3W	.13	.06	1.196	.489
N3D	.20	.04	.973	.197
N3W	.13	.04	.413	.262
B4D	.16	.04	.152	.226
B4W	.14	.04	.954	.267
M4D	.22	.05	.196	.208
M4W	.17	.05	.144	.323
N4D	.23	.17	2.995	.732
N4W	.15	.03	.178	.229
DRY RUNS	.1950	.0526	N= 12	
WET RUNS	.1601	.0402	N= 12	

Table G.6. Statistics by Run Type.

```
CHLORIDE, CL- (MG/L)
          RUN TYPE             MEAN          STD DEV   COEF OF SKEW     COEF OF VAR

              B1D               .88              .62          1.479            .703
              B1W              1.93             2.72          1.733           1.408
              M1D              5.16             2.51          1.222            .487
              M1W              2.44             1.11          1.449            .457
              N1D              5.74             5.49          2.296            .957
              N1W              1.91             1.22           .885            .637
              B2D              1.19             1.26          2.155           1.054
              B2W              1.52             1.75          2.014           1.153
              M2D              3.73             1.89          1.398            .506
              M2W              2.14             1.29          1.366            .602
              N2D              5.50             3.99          1.085            .725
              N2W              3.16             1.71           .390            .542
              B3D              2.46             3.65          1.482           1.481
              B3W              2.28             3.23          1.661           1.416
              M3D              4.50             2.57          1.476            .571
              M3W              2.21             1.44           .910            .649
              N3D              8.64            14.32          3.498           1.657
              N3W              3.00             1.33           .590            .442
              B4D              1.44             1.41          2.458            .982
              B4W              1.30             1.52          1.947           1.165
              M4D              3.21             2.32          1.485            .722
              M4W              2.61             2.51          1.774            .963
              N4D              4.51             3.32           .804            .735
              N4W              2.28             1.70          2.146            .744

          DRY RUNS           3.9145           2.2524          N= 12

          WET RUNS           2.2322            .5414          N= 12
```

Table G.7. Statistics by Run Type.

```
SULFATE, S04= (MG/L)
        RUN TYPE               MEAN            STD DEV    COEF OF SKEW     COEF OF VAR

             B1D             133.17              70.94            .785            .533
             B1W             117.67              84.00           1.099            .714
             M1D             136.17              84.95           1.304            .624
             M1W             117.87              77.03           1.139            .654
             N1D             128.43              72.85           1.181            .567
             N1W             111.12             103.98           1.357            .936
             B2D             202.10             175.49           1.226            .868
             B2W             151.58             122.27           1.153            .807
             M2D             189.37             136.92           1.735            .723
             M2W             175.53             173.41           1.863            .988
             N2D             147.93             101.85            .889            .688
             N2W             102.17              65.18           1.073            .638
             B3D             266.20             238.60           1.627            .896
             B3W             213.10             185.22           1.184            .869
             M3D             152.87             117.24            .993            .767
             M3W             103.87              83.05            .943            .800
             N3D             223.10             214.01           1.692            .959
             N3W             168.00             159.10           1.410            .947
             B4D             187.47             129.34            .874            .690
             B4W             283.30             370.83           3.011           1.309
             M4D             342.83             244.48            .939            .713
             M4W             269.44             185.03            .917            .687
             N4D             210.43             122.38            .542            .582
             N4W             195.40             154.25           1.070            .789

        DRY RUNS           193.3385            63.0756          N= 12

        WET RUNS           167.4204            62.8274          N= 12
```

Table G.8. Statistics by Run Type.

SODIUM, NA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	1.81	.67	1.058	.367
B1W	1.39	.68	.578	.488
M1D	8.31	3.35	.313	.403
M1W	4.70	2.56	1.396	.543
N1D	8.31	4.51	.058	.542
N1W	5.27	3.27	.393	.621
B2D	2.56	2.73	2.832	1.069
B2W	1.93	1.95	3.248	1.009
M2D	6.89	5.07	1.929	.736
M2W	4.20	3.36	1.930	.800
N2D	9.60	5.87	.784	.612
N2W	6.09	3.61	1.088	.593
B3D	6.03	8.94	1.538	1.482
B3W	4.00	6.97	2.223	1.741
M3D	7.92	3.80	.816	.480
M3W	5.82	3.97	.873	.683
N3D	10.71	7.17	1.297	.669
N3W	6.38	5.11	2.720	.801
B4D	3.84	7.20	3.341	1.873
B4W	2.07	2.55	3.378	1.234
M4D	7.32	4.15	.968	.567
M4W	3.94	2.22	1.330	.563
N4D	7.84	4.28	.371	.546
N4W	5.39	3.93	2.453	.729
DRY RUNS	6.7633	2.7392	N= 12	
WET RUNS	4.2647	1.6894	N= 12	

Table G.9. Statistics by Run Type.

POTASSIUM, K (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	2.54	1.29	.401	.509
B1W	1.91	.87	.719	.454
M1D	4.37	1.17	-1.054	.268
M1W	2.85	1.10	.157	.384
N1D	4.11	.96	-.369	.234
N1W	2.68	.69	.125	.258
B2D	3.57	.94	-.122	.263
B2W	1.81	.75	-.056	.414
M2D	4.23	1.54	1.073	.364
M2W	2.44	.95	.156	.388
N2D	6.03	3.09	.509	.513
N2W	3.53	1.80	.492	.511
B3D	3.79	2.11	.819	.558
B3W	2.50	1.41	.802	.565
M3D	5.51	1.73	-.161	.314
M3W	3.56	1.35	.710	.381
N3D	4.75	1.64	.143	.346
N3W	3.55	.96	.197	.270
B4D	4.41	1.83	1.357	.415
B4W	3.45	2.68	1.466	.777
M4D	6.97	1.97	.012	.283
M4W	4.49	2.13	1.052	.474
N4D	5.18	1.97	-.421	.381
N4W	3.93	.95	-.478	.243
DRY RUNS	4.6211	1.1784	N= 12	
WET RUNS	3.0594	.8216	N= 12	

Table G.10. Statistics by Run Type.

```
CALCIUM, CA (MG/L)
    RUN TYPE              MEAN             STD DEV     COEF OF SKEW      COEF OF VAR

         B1D              39.62              18.80             .130             .475
         B1W              35.06              18.39             .329             .525
         M1D              38.51              19.35            1.222             .502
         M1W              33.40              19.89            1.094             .596
         N1D              33.22              19.01            2.051             .572
         N1W              28.18              17.60            1.132             .625
         B2D              47.06              25.41             .374             .540
         B2W              42.78              28.74             .863             .672
         M2D              49.16              21.75             .087             .442
         M2W              38.50              27.11            1.295             .704
         N2D              39.83              25.25            1.353             .634
         N2W              32.06              16.17             .287             .504
         B3D              61.32              34.79             .296             .567
         B3W              58.47              43.04            1.128             .736
         M3D              44.95              34.81            1.890             .774
         M3W              35.95              24.32            1.713             .677
         N3D              45.11              24.04             .096             .533
         N3W              36.07              24.21             .826             .671
         B4D              45.68              32.56            1.651             .713
         B4W              44.06              20.24            -.499             .459
         M4D              71.25              30.77             .349             .432
         M4W              58.21              27.54             .237             .473
         N4D              61.19              33.01            1.455             .589
         N4W              49.04              36.16            2.025             .737

    DRY RUNS         48.0735            11.1290            N= 12

    WET RUNS         40.9812             9.8720            N= 12
```

Table G.11. Statistics by Run Type.

MAGNESIUM, MG (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1D	1.82	.55	.033	.301
B1W	1.59	.72	.528	.449
M1D	2.27	.83	.305	.364
M1W	1.75	.64	.184	.363
N1D	2.44	.79	.686	.322
N1W	1.81	.64	-.045	.356
B2D	2.19	.69	.544	.317
B2W	1.76	.70	.231	.395
M2D	2.51	.71	-.472	.284
M2W	1.67	.44	-.153	.263
N2D	2.46	.78	.030	.316
N2W	2.07	1.04	.869	.502
B3D	3.27	1.21	.139	.370
B3W	2.34	1.06	.255	.455
M3D	2.70	.91	-.369	.338
M3W	1.95	.79	.544	.404
N3D	2.78	1.19	.752	.429
N3W	2.27	1.02	.263	.450
B4D	2.40	.95	.162	.398
B4W	2.22	1.09	.545	.491
M4D	3.74	1.91	1.338	.510
M4W	2.56	1.09	.964	.427
N4D	3.03	.91	1.063	.300
N4W	2.52	.84	.632	.333
DRY RUNS	2.6340	.5167	N= 12	
WET RUNS	2.0425	.3360	N= 12	

Table G.12. Laboratory Electric Conductivity Statistics by Plot Type.

```
ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)

        RUN TYPE              MEAN          STD DEV    COEF OF SKEW     COEF OF VAR

           B1                336.3           172.9              .7             .51
           M1                348.8           175.9             1.1             .50
           N1                314.9           161.0             1.3             .51
           B2                457.8           288.0              .8             .63
           M2                461.9           258.8              .6             .56
           N2                342.4           195.8             1.1             .57
           B3                621.6           398.3              .6             .64
           M3                352.6           214.0              .9             .61
           N3                455.4           301.4             1.2             .66
           B4                430.2           226.5              .4             .53
           M4                708.5           375.8              .4             .53
           N4                526.5           316.0             1.2             .60

        ALL RUNS          446.4056        122.5144           N= 12
```

Table G.13. Laboratory pH Statistics by Plot Type.

```
 PH

        RUN TYPE              MEAN          STD DEV    COEF OF SKEW     COEF OF VAR

           B1                  8.0              .5             -.3             .06
           M1                  7.9              .4              .1             .05
           N1                  8.2              .5             -.5             .06
           B2                  7.6              .4             1.3             .05
           M2                  7.5              .4             1.4             .06
           N2                  7.8              .5              .3             .07
           B3                  8.0              .5              .4             .06
           M3                  8.0              .7              .1             .08
           N3                  7.9              .5              .0             .07
           B4                  8.0              .5              .5             .07
           M4                  8.3              .7             1.1             .08
           N4                  8.1              .5             -.3             .06

        ALL RUNS            7.9272           .2406           N= 12
```

Table G.14. Statistics by Plot Type.

TOTAL ALKALINITY AS CACO3 (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	14.7183	1.6932	.3464	.1150
M1	17.5643	2.8760	.6818	.1637
N1	18.2387	3.1440	.2541	.1724
B2	15.2250	2.5200	.6806	.1655
M2	16.7287	3.4555	1.5989	.2066
N2	18.9283	4.4966	.8414	.2376
B3	17.2803	5.4611	1.3509	.3160
M3	18.4580	3.0235	.1075	.1638
N3	18.6267	3.7673	-.0462	.2023
B4	16.8050	4.5171	2.6628	.2688
M4	18.1920	3.4050	.6662	.1872
N4	18.4190	2.8065	1.2229	.1524
ALL RUNS	17.3984	1.3151	N= 12	

Table G.15. Statistics by Plot Type.

TOTAL DISSOLVED SOLIDS (G/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	.2494	.1290	.7756	.5173
M1	.2548	.1445	1.0699	.5671
N1	.2506	.1476	1.0487	.5890
B2	.3533	.3032	1.5928	.8583
M2	.3462	.2219	.8074	.6409
N2	.2484	.1726	1.3049	.6949
B3	.5844	.5608	2.5819	.9596
M3	.2709	.1729	.8935	.6384
N3	.3691	.2727	1.2696	.7390
B4	.3492	.2116	.8164	.6059
M4	.5898	.3620	.4876	.6138
N4	.3979	.2340	.8040	.5881
ALL RUNS	.3553	.1208	N= 12	

Table G.16. Statistics by Plot Type.

FLOURIDE,F- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	.15	.05	.770	.348
M1	.14	.05	.453	.346
N1	.18	.13	3.926	.714
B2	.14	.04	.690	.311
M2	.18	.13	3.099	.708
N2	.20	.13	3.272	.655
B3	.29	.30	1.715	1.023
M3	.15	.06	.189	.375
N3	.17	.05	.423	.292
B4	.15	.04	.470	.255
M4	.20	.06	-.064	.293
N4	.19	.13	4.187	.662
ALL RUNS	.1774	.0429	N= 12	

Table G.17. Statistics by Plot Type.

CHLORIDE, CL- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	1.41	2.01	2.699	1.429
M1	3.80	2.36	1.549	.621
N1	3.82	4.37	3.127	1.142
B2	1.36	1.51	2.162	1.111
M2	2.93	1.78	1.418	.608
N2	4.33	3.24	1.635	.749
B3	2.37	3.39	1.545	1.428
M3	3.36	2.35	1.590	.701
N3	5.82	10.40	5.027	1.785
B4	1.37	1.44	2.124	1.052
M4	2.91	2.40	1.552	.823
N4	3.36	2.80	1.448	.833
ALL RUNS	3.0702	1.3333	N= 12	

Table G.18. Statistics by Plot Type.

SULFATE, SO4= (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	125.42	76.80	.907	.612
M1	127.02	80.22	1.226	.632
N1	119.78	88.65	1.224	.740
B2	176.84	150.82	1.362	.853
M2	182.45	153.68	1.787	.842
N2	125.05	87.18	1.187	.697
B3	239.65	211.60	1.552	.883
M3	128.37	102.89	1.147	.802
N3	195.55	187.39	1.706	.958
B4	235.38	277.19	3.808	1.178
M4	306.14	216.28	1.039	.706
N4	202.66	137.51	.862	.679
ALL RUNS	180.3578	59.0871	N= 12	

Table G.19. Statistics by Plot Type.

SODIUM, NA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	1.60	.69	.668	.434
M1	6.51	3.46	.704	.531
N1	6.79	4.17	.426	.614
B2	2.24	2.35	3.057	1.049
M2	5.54	4.44	2.058	.801
N2	7.84	5.11	1.155	.652
B3	5.02	7.94	1.817	1.583
M3	6.87	3.97	.709	.578
N3	8.55	6.50	1.725	.760
B4	2.96	5.38	4.278	1.821
M4	5.63	3.69	1.392	.656
N4	6.57	4.22	1.202	.642
ALL RUNS	5.5105	2.1954	N= 12	

Table G.20. Statistics by Plot Type.

POTASSIUM, K (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	2.23	1.13	.733	.506
M1	3.61	1.36	-.200	.375
N1	3.39	1.10	.260	.323
B2	2.69	1.23	.198	.455
M2	3.33	1.55	1.035	.465
N2	4.78	2.79	.925	.584
B3	3.14	1.88	1.053	.599
M3	4.53	1.82	.352	.401
N3	4.15	1.46	.642	.351
B4	3.93	2.31	1.164	.587
M4	5.73	2.38	.265	.415
N4	4.55	1.65	.245	.363
ALL RUNS	3.8403	.9757	N= 12	

Table G.21. Statistics by Plot Type.

CALCIUM, CA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	37.34	18.42	.225	.493
M1	35.96	19.46	1.094	.541
N1	30.70	18.18	1.604	.592
B2	44.92	26.74	.618	.595
M2	43.83	24.75	.683	.565
N2	35.95	21.21	1.355	.590
B3	59.90	38.48	.814	.642
M3	40.45	29.86	1.985	.738
N3	40.59	24.15	.428	.595
B4	44.87	26.65	1.343	.594
M4	64.73	29.45	.348	.455
N4	54.91	35.97	1.643	.655
ALL RUNS	44.5099	10.3345	N= 12	

Table G.22. Statistics by Plot Type.

MAGNESIUM, MG (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
B1	1.71	.64	.218	.373
M1	2.01	.77	.463	.384
N1	2.13	.78	.527	.366
B2	1.97	.72	.325	.362
M2	2.09	.72	.300	.345
N2	2.26	.92	.408	.407
B3	2.80	1.21	.271	.433
M3	2.32	.92	.143	.396
N3	2.53	1.12	.621	.444
B4	2.31	1.01	.347	.438
M4	3.15	1.64	1.598	.520
N4	2.77	.90	.811	.324
ALL RUNS	2.3375	.4100	N= 12	

Table G.23. Laboratory Electric Conductivity Statistics by Replication for All Runs.

ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	467.3	225.6	.5	.48
REP 2	456.9	317.0	1.9	.69
REP 3	444.7	299.5	1.5	.67
REP 4	433.1	311.6	1.4	.72
REP 5	402.2	185.0	.8	.46
REP 6	313.0	153.8	.8	.49
REP 7	631.3	419.7	.5	.66
REP 8	435.9	346.6	1.2	.80
REP 9	626.9	304.6	.7	.49
REP10	445.6	215.7	1.3	.48
REP11	398.2	299.8	1.3	.75
REP12	423.6	259.9	.6	.61
REP13	507.4	270.1	.5	.53
REP14	349.3	223.7	1.6	.64
REP15	360.6	274.9	2.2	.76
ALL REPS	446.4056	88.9179	N= 15	

Table G.24. Laboratory pH Statistics by Replication for All Runs.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	7.9	.4	.4	.05
REP 2	7.9	.3	-.4	.04
REP 3	7.9	.4	.5	.06
REP 4	8.0	.7	1.4	.09
REP 5	7.9	.7	1.7	.09
REP 6	7.8	.5	.9	.07
REP 7	7.9	.6	.1	.08
REP 8	7.8	.8	.5	.10
REP 9	7.7	.6	.5	.08
REP10	7.9	.5	.0	.06
REP11	8.0	.5	-.1	.07
REP12	8.0	.5	.0	.06
REP13	7.9	.6	.2	.08
REP14	8.0	.6	.0	.07
REP15	8.2	.5	-.6	.07
ALL REPS	7.9272	.0923	N= 15	

Table G.25. Statistics by Replication for All Runs.

TOTAL ALKALINITY AS CACO3 (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	17.0075	3.9326	1.0274	.2312
REP 2	16.0321	2.6916	.3584	.1679
REP 3	17.2804	5.3421	1.8129	.3091
REP 4	18.8575	4.3169	.8402	.2289
REP 5	19.7154	4.1496	.5032	.2105
REP 6	19.0483	4.3520	1.0659	.2285
REP 7	16.3254	3.6325	.6622	.2225
REP 8	16.5813	2.5941	.1919	.1564
REP 9	15.9108	4.3806	1.8479	.2753
REP10	17.9679	3.5418	.4208	.1971
REP11	17.2563	2.7631	.6606	.1601
REP12	16.9296	2.4554	-.0697	.1450
REP13	16.2067	2.2929	1.8318	.1415
REP14	17.5550	2.6951	-.4283	.1535
REP15	18.8063	3.6792	1.5818	.1956
ALL REPS	17.3977	1.1678	N= 15	

Table G.26. Statistics by Replication for All Runs.

TOTAL DISSOLVED SOLIDS (G/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.3726	.2215	.7009	.5943
REP 2	.3293	.1957	1.5972	.5945
REP 3	.3743	.3014	1.7894	.8052
REP 4	.3408	.2618	1.3914	.7681
REP 5	.3155	.1569	1.1248	.4972
REP 6	.2475	.1227	.5200	.4958
REP 7	.5421	.4068	.7012	.7504
REP 8	.3460	.3236	1.6691	.9354
REP 9	.5722	.5656	3.1670	.9885
REP10	.3573	.2080	1.1052	.5820
REP11	.2980	.2495	1.4946	.8373
REP12	.3037	.2226	.6410	.7329
REP13	.3938	.2380	1.0174	.6043
REP14	.2633	.2276	1.6734	.8642
REP15	.2736	.2321	1.9468	.8485
ALL REPS	.3553	.0923	N= 15	

Table G.27. Statistics by Replication for All Runs.

FLOURIDE,F- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.19	.14	4.027	.698
REP 2	.16	.05	.093	.315
REP 3	.15	.04	-.188	.260
REP 4	.25	.23	2.628	.907
REP 5	.24	.21	2.557	.894
REP 6	.23	.18	3.856	.776
REP 7	.18	.07	.589	.365
REP 8	.15	.05	.567	.337
REP 9	.15	.05	-.066	.294
REP10	.15	.06	.704	.391
REP11	.14	.05	1.064	.370
REP12	.14	.06	1.256	.389
REP13	.17	.14	3.988	.820
REP14	.20	.19	2.746	.949
REP15	.17	.06	-.099	.344
ALL REPS	.1774	.0364	N= 15	

Table G.28. Statistics by Replication for All Runs.

CHLORIDE, CL- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	3.31	2.43	.953	.734
REP 2	3.31	2.48	1.070	.748
REP 3	2.43	2.52	2.509	1.036
REP 4	3.17	2.48	1.194	.782
REP 5	4.19	2.90	.488	.692
REP 6	3.05	2.28	1.788	.747
REP 7	4.54	12.30	4.339	2.712
REP 8	1.72	1.57	1.188	.909
REP 9	1.97	1.83	1.935	.929
REP10	3.62	3.18	.765	.877
REP11	2.08	1.67	1.119	.802
REP12	2.95	2.48	1.359	.842
REP13	2.58	1.92	.767	.745
REP14	3.20	4.99	3.025	1.562
REP15	3.98	3.59	1.500	.901
ALL REPS	3.0734	.8177	N= 15	

Table G.29. Statistics by Replication for All Runs.

SULFATE, SO4= (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	174.54	112.25	.806	.643
REP 2	155.44	115.17	1.953	.741
REP 3	163.75	117.76	1.181	.719
REP 4	156.98	119.74	.964	.763
REP 5	124.56	71.64	.766	.575
REP 6	97.96	61.45	.783	.627
REP 7	289.59	253.15	.886	.874
REP 8	204.03	232.44	1.832	1.139
REP 9	283.10	179.48	1.070	.634
REP10	249.50	317.11	3.279	1.271
REP11	165.60	153.01	1.591	.924
REP12	174.23	120.73	.590	.693
REP13	207.44	130.31	.895	.628
REP14	128.26	111.85	1.577	.872
REP15	134.01	107.11	1.783	.799
ALL REPS	180.5993	56.7317	N= 15	

Table G.30. Statistics by Replication for All Runs.

SODIUM, NA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	5.92	5.06	.903	.856
REP 2	6.14	7.49	2.049	1.221
REP 3	6.25	6.76	1.905	1.083
REP 4	6.39	6.06	1.547	.948
REP 5	6.71	5.82	1.490	.868
REP 6	6.51	6.12	1.869	.940
REP 7	5.36	4.61	1.113	.861
REP 8	3.60	2.97	1.263	.825
REP 9	3.81	4.60	2.291	1.209
REP10	6.29	4.84	.684	.769
REP11	4.79	3.58	.818	.746
REP12	5.82	4.53	.985	.778
REP13	4.52	2.87	1.032	.634
REP14	4.40	3.21	1.240	.730
REP15	6.10	4.81	1.629	.788
ALL REPS	5.5071	1.0232	N= 15	

Table G.31. Statistics by Replication for All Runs.

```
POTASSIUM, K (MG/L)

     RUN TYPE              MEAN           STD DEV   COEF OF SKEW    COEF OF VAR

        REP  1             4.27              2.95          1.135           .690
        REP  2             3.59              2.29          1.518           .637
        REP  3             3.73              2.29           .976           .613
        REP  4             4.50              1.66           .558           .370
        REP  5             4.50              2.17          1.860           .483
        REP  6             3.97              1.78           .110           .449
        REP  7             3.93              2.00          -.160           .510
        REP  8             3.26              1.37           .244           .420
        REP  9             4.28              2.15           .953           .502
        REP10              3.98              1.98           .403           .498
        REP11              3.34              1.67           .994           .501
        REP12              3.73              2.32           .650           .622
        REP13              3.52              1.38           .004           .391
        REP14              3.30              1.42          1.204           .431
        REP15              3.70              1.90          1.087           .514

     ALL  REPS           3.8403             .4123          N= 15
```

Table G.32. Statistics by Replication for All Runs.

```
CALCIUM, CA (MG/L)

     RUN TYPE              MEAN           STD DEV   COEF OF SKEW    COEF OF VAR

        REP  1            58.25             36.58          1.002           .628
        REP  2            50.75             39.61          1.744           .780
        REP  3            39.02             24.64          1.051           .632
        REP  4            37.32             20.07           .944           .538
        REP  5            40.10             20.46           .379           .510
        REP  6            34.46             16.81           .854           .488
        REP  7            54.97             31.29           .137           .569
        REP  8            40.23             25.03           .567           .622
        REP  9            57.67             20.65          -.067           .358
        REP10             38.65             15.27           .851           .395
        REP11             39.61             28.33          1.125           .715
        REP12             39.07             26.10           .664           .668
        REP13             55.77             31.07           .494           .557
        REP14             37.75             26.68          1.480           .707
        REP15             44.03             36.74          2.256           .834

     ALL  REPS          44.5101            8.4161          N= 15
```

Table G.33. Statistics by Replication for All Runs.

MAGNESIUM, MG (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	2.69	1.23	.758	.456
REP 2	2.83	1.66	2.049	.585
REP 3	2.78	1.31	.008	.470
REP 4	2.61	1.09	.351	.419
REP 5	2.63	.82	1.080	.312
REP 6	2.33	1.09	1.032	.469
REP 7	2.25	.82	.014	.364
REP 8	1.89	.60	-.033	.318
REP 9	2.13	.56	.546	.261
REP10	2.46	.80	.171	.327
REP11	2.06	.82	.707	.397
REP12	2.30	.95	.434	.414
REP13	2.49	1.12	1.036	.452
REP14	1.75	.76	.968	.436
REP15	1.84	.90	1.181	.488
ALL REPS	2.3361	.3472	N= 15	

Table G.34. Laboratory Electric Conductivity Statistics by Replication for Dry Runs.

ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	531.5	244.8	.3	.46
REP 2	527.5	365.9	1.9	.69
REP 3	491.7	345.5	1.5	.70
REP 4	470.0	356.8	1.5	.76
REP 5	431.0	203.5	.7	.47
REP 6	341.0	157.8	1.0	.46
REP 7	684.3	460.9	.5	.67
REP 8	457.5	362.9	1.5	.79
REP 9	672.1	331.8	.8	.49
REP10	469.2	179.6	1.4	.38
REP11	430.8	339.0	1.4	.79
REP12	433.8	270.3	.6	.62
REP13	565.8	276.3	.7	.49
REP14	399.1	239.7	1.5	.60
REP15	370.0	246.1	1.9	.67
DRY REPS	485.0111	98.6693	N= 15	

Table G.35. Laboratory pH Statistics by Replication for Dry Runs.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	7.9	.4	.6	.05
REP 2	8.1	.3	-.3	.03
REP 3	7.9	.4	.1	.05
REP 4	8.0	.8	1.7	.10
REP 5	7.9	.7	2.4	.09
REP 6	7.9	.6	1.1	.07
REP 7	7.9	.6	.4	.07
REP 8	7.9	.8	.2	.11
REP 9	7.6	.5	.8	.07
REP10	8.0	.4	-.2	.06
REP11	8.1	.5	-.6	.06
REP12	8.0	.5	-.1	.06
REP13	7.8	.5	-.1	.07
REP14	7.8	.5	.2	.06
REP15	8.3	.4	-.8	.05
DRY REPS	7.9383	.1574	N= 15	

Table G.36. Statistics by Replication for Dry Runs.

TOTAL ALKALINITY AS CACO3 (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	17.0317	2.3937	-.0081	.1405
REP 2	16.9975	2.7596	.4975	.1624
REP 3	19.0200	6.1727	1.8513	.3245
REP 4	19.9208	4.6197	.7943	.2319
REP 5	20.9442	4.4589	.2033	.2129
REP 6	20.1150	4.4144	.8457	.2195
REP 7	17.5983	3.8622	.3948	.2195
REP 8	17.3783	2.6119	-.2497	.1503
REP 9	16.2092	4.0663	2.2690	.2509
REP10	18.4525	3.0590	.4079	.1658
REP11	18.5558	2.9458	.0209	.1588
REP12	17.9708	2.4149	-.2064	.1344
REP13	16.8500	2.4455	2.0739	.1451
REP14	17.9083	2.4267	-.0263	.1355
REP15	19.8717	4.2795	1.5410	.2154
DRY REPS	18.2563	1.3423	N= 15	

Table G.37. Statistics by Replication for Dry Runs.

TOTAL DISSOLVED SOLIDS (G/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.4380	.2498	.3695	.5703
REP 2	.3463	.1776	1.0861	.5130
REP 3	.4267	.3744	1.4774	.8774
REP 4	.3778	.2955	1.3198	.7820
REP 5	.3369	.1764	.9050	.5237
REP 6	.2621	.1251	.6477	.4773
REP 7	.5947	.4587	.7441	.7714
REP 8	.3717	.3594	1.9800	.9671
REP 9	.6819	.7571	2.4474	1.1103
REP10	.3462	.1716	.6706	.4957
REP11	.3398	.2923	1.5280	.8600
REP12	.3203	.2347	.7540	.7330
REP13	.4522	.2588	1.3066	.5723
REP14	.3004	.2428	1.1374	.8082
REP15	.3037	.2300	1.9681	.7575
DRY REPS	.3932	.1136	N= 15	

Table G.38. Statistics by Replication for Dry Runs.

FLOURIDE,F- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.23	.18	3.013	.804
REP 2	.18	.05	.000	.298
REP 3	.18	.03	-.072	.143
REP 4	.27	.24	2.847	.882
REP 5	.24	.23	2.768	.966
REP 6	.28	.23	2.845	.837
REP 7	.21	.07	.431	.339
REP 8	.16	.05	.292	.306
REP 9	.16	.05	-.514	.308
REP10	.18	.05	.981	.297
REP11	.16	.05	.812	.323
REP12	.14	.06	1.665	.392
REP13	.17	.04	.054	.256
REP14	.21	.19	2.826	.945
REP15	.17	.06	-.691	.337
DRY REPS	.1949	.0421	N= 15	

Table G.39. Statistics by Replication for Dry Runs.

CHLORIDE, CL- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	3.38	2.61	1.275	.773
REP 2	3.50	2.87	1.282	.819
REP 3	3.45	3.14	1.862	.908
REP 4	3.44	2.62	.749	.762
REP 5	4.55	3.13	.255	.686
REP 6	3.73	2.80	1.383	.752
REP 7	8.19	17.44	2.836	2.129
REP 8	2.38	1.95	.348	.823
REP 9	2.51	2.30	1.419	.918
REP10	4.83	3.73	.213	.773
REP11	2.77	2.02	.422	.730
REP12	2.51	1.97	.536	.784
REP13	3.48	2.16	.123	.619
REP14	4.94	6.65	1.955	1.346
REP15	5.35	4.50	.762	.841
DRY REPS	3.9349	1.4971	N= 15	

Table G.40. Statistics by Replication for Dry Runs.

SULFATE, SO4= (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	215.00	125.72	.444	.585
REP 2	169.92	103.71	1.234	.610
REP 3	159.50	128.31	1.167	.804
REP 4	183.42	125.63	1.082	.685
REP 5	144.38	72.40	.632	.501
REP 6	99.00	65.79	1.027	.665
REP 7	319.36	290.59	.953	.910
REP 8	222.04	266.96	1.917	1.202
REP 9	311.67	197.61	1.254	.634
REP10	200.71	130.57	2.439	.651
REP11	180.83	178.35	1.696	.986
REP12	181.46	131.55	.708	.725
REP13	243.71	143.10	1.062	.587
REP14	138.21	109.92	1.692	.795
REP15	139.96	104.67	1.756	.748
DRY REPS	193.9437	61.5505	N= 15	

Table G.41. Statistics by Replication for Dry Runs.

SODIUM, NA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	6.71	5.11	.249	.762
REP 2	7.44	8.51	1.841	1.144
REP 3	8.29	8.34	1.420	1.006
REP 4	7.76	6.62	1.247	.854
REP 5	8.73	7.04	1.008	.806
REP 6	7.12	6.88	1.505	.965
REP 7	6.33	5.31	1.009	.838
REP 8	4.86	3.43	.762	.706
REP 9	5.00	5.37	1.928	1.074
REP10	7.81	5.72	.206	.733
REP11	6.25	4.12	.180	.660
REP12	6.78	5.19	.743	.765
REP13	5.81	3.45	.250	.595
REP14	5.25	3.72	1.048	.710
REP15	7.20	5.96	1.285	.828
DRY REPS	6.7550	1.1799	N= 15	

Table G.42. Statistics by Replication for Dry Runs.

POTASSIUM, K (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	4.94	2.71	1.181	.549
REP 2	4.38	2.67	1.331	.611
REP 3	4.38	2.50	.641	.571
REP 4	5.47	1.61	.143	.295
REP 5	5.33	2.47	1.835	.464
REP 6	4.93	1.53	-.024	.310
REP 7	4.52	2.18	-.859	.483
REP 8	3.68	1.28	.283	.348
REP 9	5.63	2.11	.606	.374
REP10	4.63	2.09	.324	.452
REP11	4.07	2.01	.260	.494
REP12	4.33	2.28	.811	.525
REP13	4.35	1.23	-.955	.283
REP14	4.03	1.55	.886	.384
REP15	4.65	2.11	.678	.454
DRY REPS	4.6211	.5519	N= 15	

Table G.43. Statistics by Replication for Dry Runs.

CALCIUM, CA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	71.53	41.38	.658	.579
REP 2	53.34	38.57	1.840	.723
REP 3	44.53	29.12	.820	.654
REP 4	38.80	20.45	.942	.527
REP 5	45.46	19.96	-.097	.439
REP 6	37.39	16.87	.968	.451
REP 7	55.64	30.61	.204	.550
REP 8	43.15	25.20	.672	.584
REP 9	61.59	21.79	-.106	.354
REP10	45.60	15.51	.651	.340
REP11	38.44	28.51	1.296	.742
REP12	40.12	28.18	.857	.702
REP13	64.81	31.15	.683	.481
REP14	37.47	26.90	1.698	.718
REP15	42.77	30.46	1.878	.712
DRY REPS	48.0427	10.8377	N= 15	

Table G.44. Statistics by Replication for Dry Runs.

```
MAGNESIUM, MG (MG/L)
    RUN TYPE               MEAN          STD DEV   COEF OF SKEW    COEF OF VAR

        REP  1             2.94           1.33          .810           .452
        REP  2             3.48           1.94         1.740           .558
        REP  3             2.89           1.46          .083           .504
        REP  4             2.98           1.18        -.023            .395
        REP  5             2.76            .78         1.670           .284
        REP  6             2.47           1.12         1.474           .453
        REP  7             2.49            .75          .688           .304
        REP  8             2.08            .49        -.403            .234
        REP  9             2.45            .51          .583           .206
        REP10              2.89            .64         1.244           .222
        REP11              2.23            .86          .464           .383
        REP12              2.53            .90          .347           .357
        REP13              3.08           1.20          .738           .389
        REP14              2.03            .82          .924           .402
        REP15              2.17            .95         1.142           .438

    DRY REPS             2.6310          .4170         N= 15
```

Table G.45. Laboratory Electric Conductivity Statistics by Replication for Wet Runs.

ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	403.2	193.6	.4	.48
REP 2	386.3	255.8	1.7	.66
REP 3	397.7	251.8	1.2	.63
REP 4	396.3	269.7	1.0	.68
REP 5	373.3	168.2	.8	.45
REP 6	285.0	151.2	.8	.53
REP 7	578.3	387.1	.2	.67
REP 8	414.3	344.2	.9	.83
REP 9	581.7	281.8	.2	.48
REP10	422.1	252.7	1.5	.60
REP11	365.6	265.8	1.0	.73
REP12	413.5	260.7	.6	.63
REP13	449.0	262.3	.2	.58
REP14	299.6	204.4	1.9	.68
REP15	351.3	311.8	2.4	.89
WET REPS	407.8000	82.3618	N= 15	

Table G.46. Laboratory pH Statistics by Replication for Wet Runs.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	7.9	.3	.2	.04
REP 2	7.8	.4	-.1	.05
REP 3	7.9	.5	.8	.06
REP 4	8.0	.7	1.0	.09
REP 5	8.0	.7	1.3	.09
REP 6	7.8	.5	.4	.06
REP 7	7.9	.6	-.2	.08
REP 8	7.8	.7	.8	.09
REP 9	7.9	.7	.2	.09
REP10	7.9	.5	.2	.07
REP11	7.9	.6	.4	.08
REP12	7.9	.5	.2	.07
REP13	8.0	.7	.1	.09
REP14	8.1	.6	-.3	.08
REP15	8.0	.7	-.2	.08
WET REPS	7.9161	.0849	N= 15	

Table G.47. Statistics by Replication for Wet Runs.

TOTAL ALKALINITY AS CACO3 (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	16.9833	5.1580	1.0082	.3037
REP 2	15.0667	2.3450	-.1447	.1556
REP 3	15.5408	3.8685	.6395	.2489
REP 4	17.7942	3.8932	.8121	.2188
REP 5	18.4867	3.5815	.7010	.1937
REP 6	17.9817	4.1991	1.5238	.2335
REP 7	15.0525	3.0228	.8167	.2008
REP 8	15.7842	2.4212	.6529	.1534
REP 9	15.6125	4.8369	1.7118	.3098
REP10	17.4833	4.0447	.6091	.2313
REP11	15.9567	1.8975	1.2195	.1189
REP12	15.8883	2.0998	-.4532	.1322
REP13	15.5633	2.0271	1.6804	.1302
REP14	17.2017	3.0044	-.5282	.1747
REP15	17.7408	2.7410	.6686	.1545
WET REPS	16.5424	1.1631	N= 15	

Table G.48. Statistics by Replication for Wet Runs.

TOTAL DISSOLVED SOLIDS (G/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.3073	.1756	.7628	.5714
REP 2	.3123	.2189	2.0017	.7010
REP 3	.3218	.2091	1.4207	.6498
REP 4	.3038	.2303	1.3422	.7579
REP 5	.2941	.1390	1.3747	.4726
REP 6	.2328	.1239	.4293	.5322
REP 7	.4895	.3599	.3736	.7352
REP 8	.3203	.2972	1.0767	.9281
REP 9	.4624	.2633	.5079	.5694
REP10	.3685	.2464	1.1497	.6687
REP11	.2561	.2023	.7848	.7898
REP12	.2871	.2188	.5065	.7622
REP13	.3355	.2099	.3222	.6257
REP14	.2263	.2152	2.5367	.9513
REP15	.2435	.2404	2.1424	.9872
WET REPS	.3174	.0756	N= 15	

Table G.49. Statistics by Replication for Wet Runs.

FLOURIDE,F- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	.16	.05	.212	.308
REP 2	.15	.05	-.017	.317
REP 3	.13	.04	.635	.284
REP 4	.24	.23	2.546	.974
REP 5	.23	.20	2.299	.859
REP 6	.17	.06	.885	.340
REP 7	.16	.05	.124	.332
REP 8	.14	.05	.961	.373
REP 9	.14	.04	.283	.275
REP10	.12	.05	.985	.402
REP11	.11	.04	1.322	.316
REP12	.14	.06	.947	.402
REP13	.17	.20	3.082	1.152
REP14	.19	.18	2.791	.995
REP15	.16	.06	.453	.366
WET REPS	.1601	.0363	N= 15	

Table G.50. Statistics by Replication for Wet Runs.

CHLORIDE, CL- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	3.25	2.36	.537	.725
REP 2	3.12	2.13	.307	.681
REP 3	1.41	1.08	1.055	.764
REP 4	2.90	2.41	1.805	.832
REP 5	3.82	2.74	.751	.716
REP 6	2.36	1.40	.906	.593
REP 7	1.19	.84	.747	.706
REP 8	1.07	.62	.210	.578
REP 9	1.43	1.02	.869	.715
REP10	2.42	2.01	.453	.829
REP11	1.39	.82	.181	.592
REP12	3.39	2.93	1.375	.866
REP13	1.68	1.14	.503	.679
REP14	1.45	1.10	1.032	.759
REP15	2.61	1.60	.675	.614
WET REPS	2.2322	.9152	N= 15	

Table G.51. Statistics by Replication for Wet Runs.

SULFATE, SO4= (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	134.08	83.47	.754	.623
REP 2	140.96	128.53	2.552	.912
REP 3	168.00	111.77	1.294	.665
REP 4	130.54	112.56	.842	.862
REP 5	104.75	68.07	1.066	.650
REP 6	96.92	59.69	.480	.616
REP 7	262.29	222.95	.531	.850
REP 8	186.02	202.47	1.449	1.088
REP 9	254.54	162.88	.620	.640
REP10	298.29	433.61	2.402	1.454
REP11	150.38	128.99	.967	.858
REP12	167.00	114.26	.375	.684
REP13	171.17	110.25	.170	.644
REP14	118.31	117.72	1.615	.995
REP15	128.06	113.83	1.908	.889
WET REPS	167.4204	59.9998	N= 15	

Table G.52. Statistics by Replication for Wet Runs.

SODIUM, NA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	5.13	5.11	1.670	.997
REP 2	4.83	6.41	2.322	1.327
REP 3	4.20	4.12	1.597	.981
REP 4	5.03	5.36	2.085	1.067
REP 5	4.68	3.53	1.063	.753
REP 6	5.90	5.50	2.487	.931
REP 7	4.47	3.89	.923	.871
REP 8	2.34	1.80	1.128	.768
REP 9	2.61	3.51	2.883	1.342
REP10	4.78	3.36	.654	.702
REP11	3.34	2.27	1.103	.679
REP12	4.85	3.72	1.058	.767
REP13	3.25	1.31	.068	.403
REP14	3.56	2.49	.961	.699
REP15	5.00	3.20	1.016	.639
WET REPS	4.2647	1.0183	N= 15	

Table G.53. Statistics by Replication for Wet Runs.

POTASSIUM, K (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	3.60	3.13	1.473	.870
REP 2	2.81	1.57	.616	.560
REP 3	3.09	1.96	1.413	.633
REP 4	3.53	1.07	.347	.304
REP 5	3.67	1.50	1.000	.408
REP 6	3.02	1.52	.400	.505
REP 7	3.33	1.69	.503	.507
REP 8	2.84	1.38	.438	.486
REP 9	2.93	1.12	.669	.381
REP10	3.33	1.70	.135	.511
REP11	2.62	.82	.110	.312
REP12	3.13	2.30	.691	.735
REP13	2.68	.96	.227	.359
REP14	2.57	.81	.150	.315
REP15	2.75	1.06	-.340	.386
WET REPS	3.0594	.3626	N= 15	

Table G.54. Statistics by Replication for Wet Runs.

CALCIUM, CA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	44.97	26.47	.897	.589
REP 2	48.16	42.16	1.785	.875
REP 3	33.51	18.85	.784	.563
REP 4	35.84	20.48	1.006	.571
REP 5	34.73	20.34	.966	.586
REP 6	31.53	16.96	.871	.538
REP 7	54.35	33.25	.104	.612
REP 8	37.31	25.61	.529	.686
REP 9	53.76	19.57	-.182	.364
REP10	31.70	11.92	1.159	.376
REP11	40.78	29.36	1.015	.720
REP12	38.02	25.05	.384	.659
REP13	46.73	29.49	.342	.631
REP14	38.02	27.66	1.342	.727
REP15	45.30	43.48	2.281	.960
WET REPS	40.9812	7.5066	N= 15	

Table G.55. Statistics by Replication for Wet Runs.

MAGNESIUM, MG (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
REP 1	2.45	1.12	.535	.458
REP 2	2.19	1.02	1.689	.468
REP 3	2.67	1.19	-.280	.446
REP 4	2.24	.91	.486	.404
REP 5	2.50	.87	.848	.348
REP 6	2.19	1.10	.652	.502
REP 7	2.03	.84	-.243	.416
REP 8	1.70	.67	.530	.391
REP 9	1.82	.41	.574	.227
REP10	2.03	.73	.076	.359
REP11	1.88	.77	1.025	.409
REP12	2.08	.99	.713	.475
REP13	1.89	.65	-.140	.345
REP14	1.47	.62	.772	.421
REP15	1.52	.75	1.296	.494
WET REPS	2.0425	.3446	N= 15	

Table G.56. Laboratory Electric Conductivity Statistics by Trampling Level.

ELECTRIC CONDUCTIVITY (MICRO MHOS/CM)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	333.3	168.7	1.0	.51
TRAMPLING2	420.7	253.9	.9	.60
TRAMPLING3	476.5	329.6	1.2	.69
TRAMPLING4	555.1	329.8	.9	.59
ALL TRAMPLING	446.4056	93.3873	N= 4	

Table G.57. Laboratory pH Statistics by Trampling Level.

PH

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	8.0	.5	-.1	.06
TRAMPLING2	7.6	.5	.9	.06
TRAMPLING3	8.0	.6	.2	.07
TRAMPLING4	8.1	.6	.8	.07
ALL TRAMPLING	7.9272	.2292	N= 4	

Table G.58. Statistics by Trampling Level.

TOTAL ALKALINITY AS CACO3 (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	16.8404	3.0338	.7015	.1801
TRAMPLING2	16.9607	3.8584	1.3119	.2275
TRAMPLING3	18.1217	4.2052	.7452	.2321
TRAMPLING4	17.8053	3.6753	1.6911	.2064
ALL TRAMPLING	17.3936	.6708	N= 4	

Table G.59. Statistics by Trampling Level.

TOTAL DISSOLVED SOLIDS (G/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	.2516	.1390	.9828	.5526
TRAMPLING2	.3159	.2409	1.5659	.7624
TRAMPLING3	,4081	.3922	3.3750	.9609
TRAMPLING4	.4456	.2933	1.0150	.6582
ALL TRAMPLING	.3553	.0880	N= 4	

Table G.60. Statistics by Trampling Level.

FLOURIDE,F- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	.16	.09	4.882	.550
TRAMPLING2	.17	.11	3.673	.643
TRAMPLING3	.20	.19	3.432	.928
TRAMPLING4	.18	.08	4.699	.473
ALL TRAMPLING	.1774	.0185	N= 4	

Table G.61. Statistics by Trampling Level.

CHLORIDE, CL- (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	3.01	3.26	3.129	1.084
TRAMPLING2	2.87	2.59	1.990	.900
TRAMPLING3	3.85	6.55	7.183	1.701
TRAMPLING4	2.54	2.41	1.744	.950
ALL TRAMPLING	3,0679	,5582	N= 4	

Table G.62. Statistics by Trampling Level.

SULFATE, SO4= (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	124.07	81.17	1.117	.654
TRAMPLING2	161.45	135.12	1.765	.837
TRAMPLING3	187.86	177.76	1.882	.946
TRAMPLING4	248.57	220.54	2.898	.887
ALL TRAMPLING	180.4854	52.3918	N= 4	

Table G.63. Statistics by Trampling Level.

SODIUM, NA (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	4.97	3.93	.945	.792
TRAMPLING2	5.21	4.70	1.685	.902
TRAMPLING3	6.81	6.45	1.554	.946
TRAMPLING4	5.04	4.70	2.295	.933
ALL TRAMPLING	5.5062	.8761	N= 4	

Table G.64. Statistics by Trampling Level.

POTASSIUM, K (MG/L)

RUN TYPE	MEAN	STD DEV	COEF OF SKEW	COEF OF VAR
TRAMPLING1	3.08	1.33	.176	.434
TRAMPLING2	3.60	2.14	1.543	.594
TRAMPLING3	3.94	1.81	.510	.459
TRAMPLING4	4.74	2.24	.620	.473
ALL TRAMPLING	3.8403	.6967	N= 4	

Table G.65. Statistics by Trampling Level.

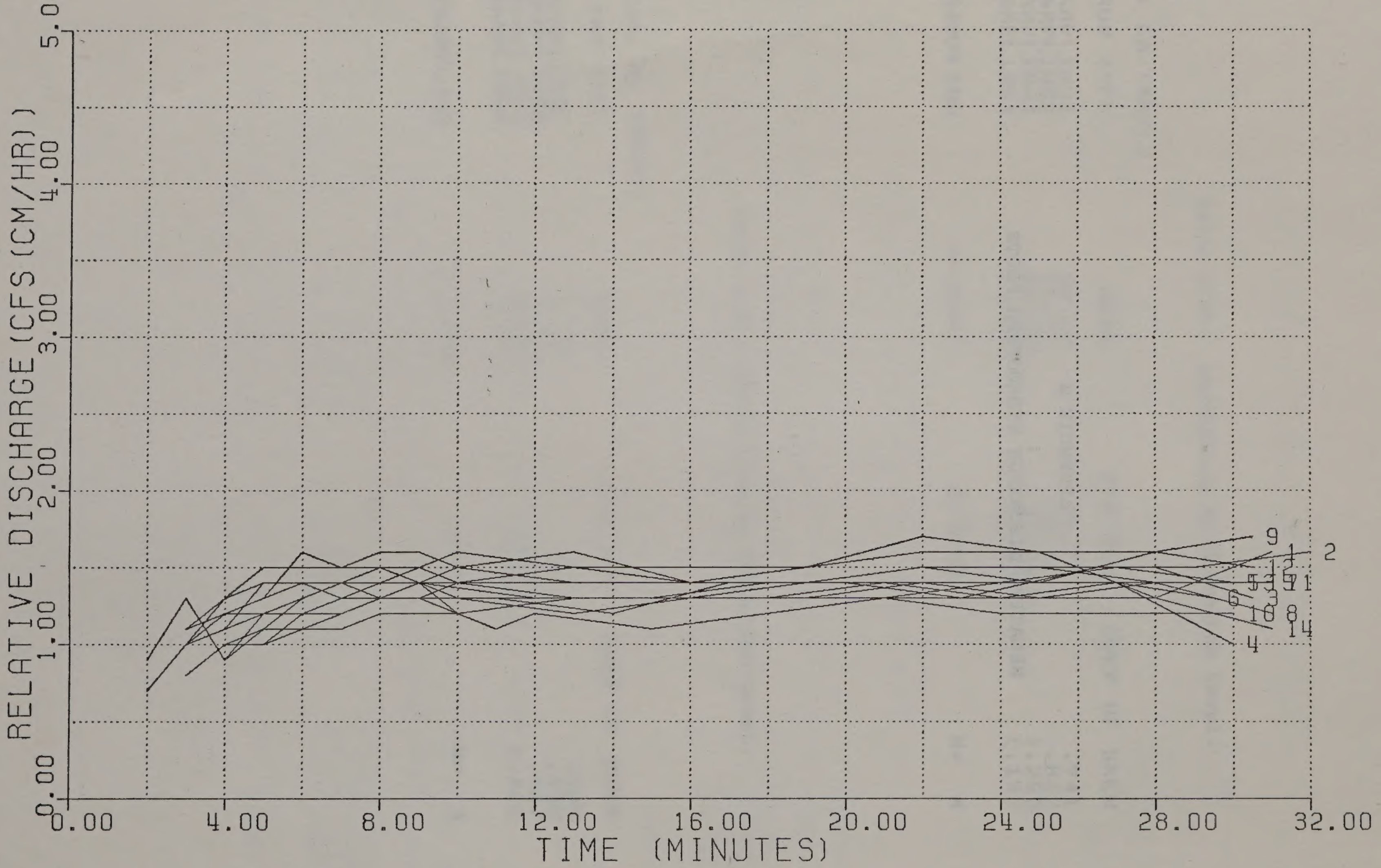
```
CALCIUM, CA (MG/L)
      RUN TYPE                MEAN          STD DEV    COEF OF SKEW     COEF OF VAR
    TRAMPLING1               34.66           18.71           .941            .540
    TRAMPLING2               41.57           24.40           .852            .587
    TRAMPLING3               46.98           32.36          1.285            .689
    TRAMPLING4               54.83           31.60          1.153            .576

  ALL TRAMPLING            44.5097          8.5295         N=  4
```

Table G.66. Statistics by Trampling Level.

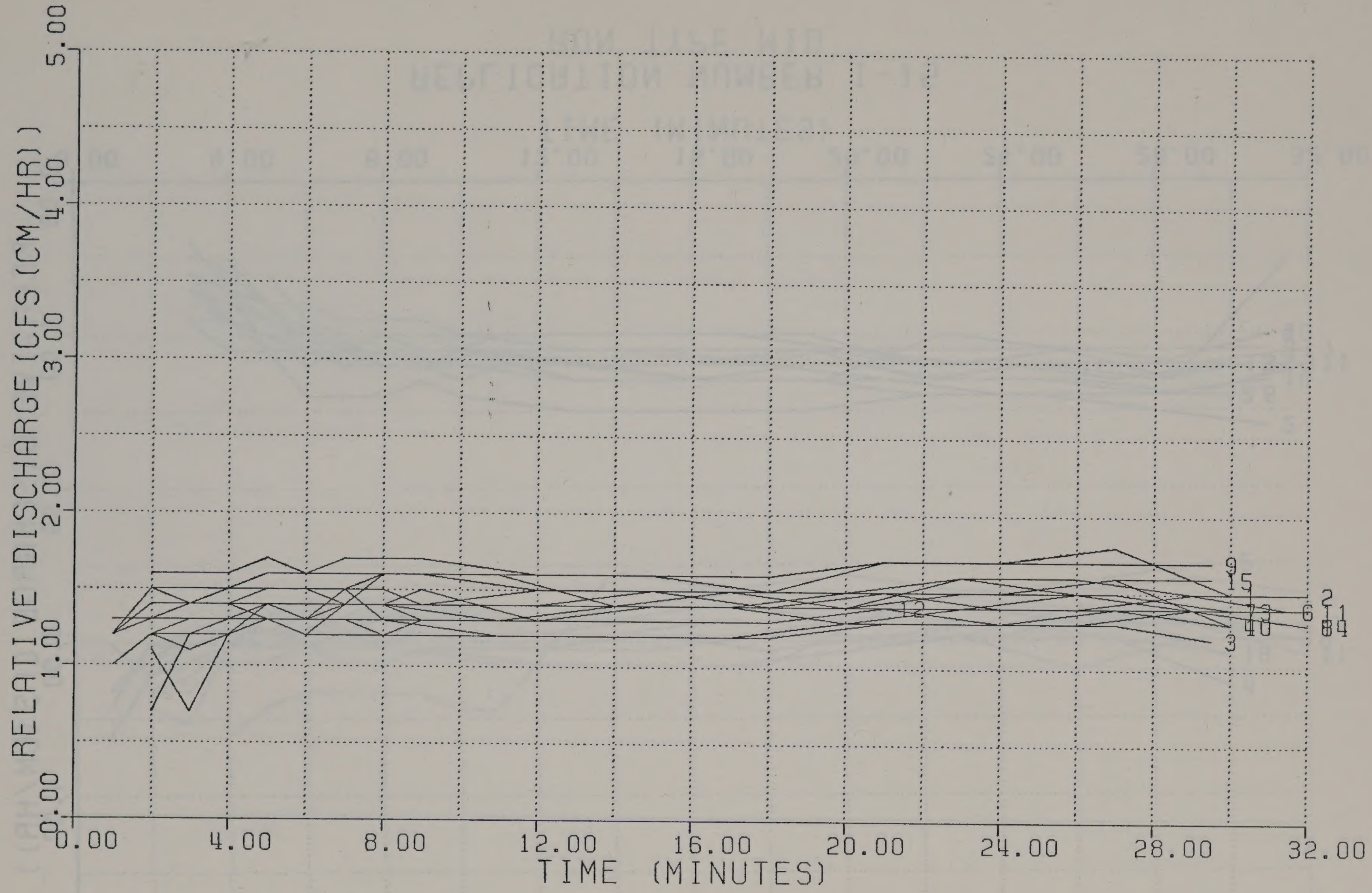
```
MAGNESIUM, MG (MG/L)
      RUN TYPE                MEAN          STD DEV    COEF OF SKEW     COEF OF VAR
    TRAMPLING1                1.95             .75           .505            .382
    TRAMPLING2                2.11             .79           .458            .376
    TRAMPLING3                2.55            1.10           .467            .431
    TRAMPLING4                2.74            1.26          1.602            .461

  ALL TRAMPLING             2.3375           .3715         N=  4
```

APPENDIX H

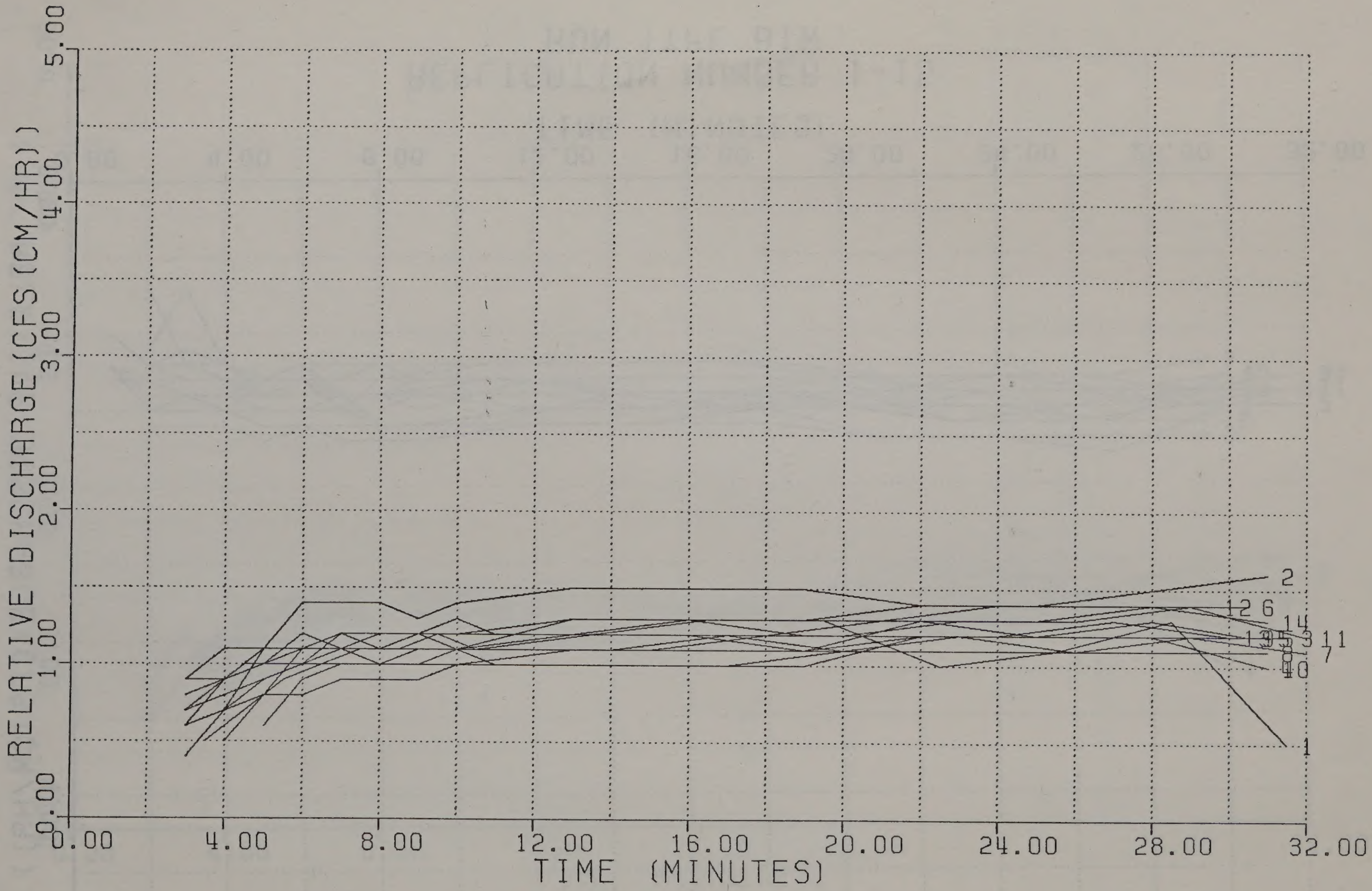
RELATIVE DISCHARGE HYDROGRAPH PLOTS



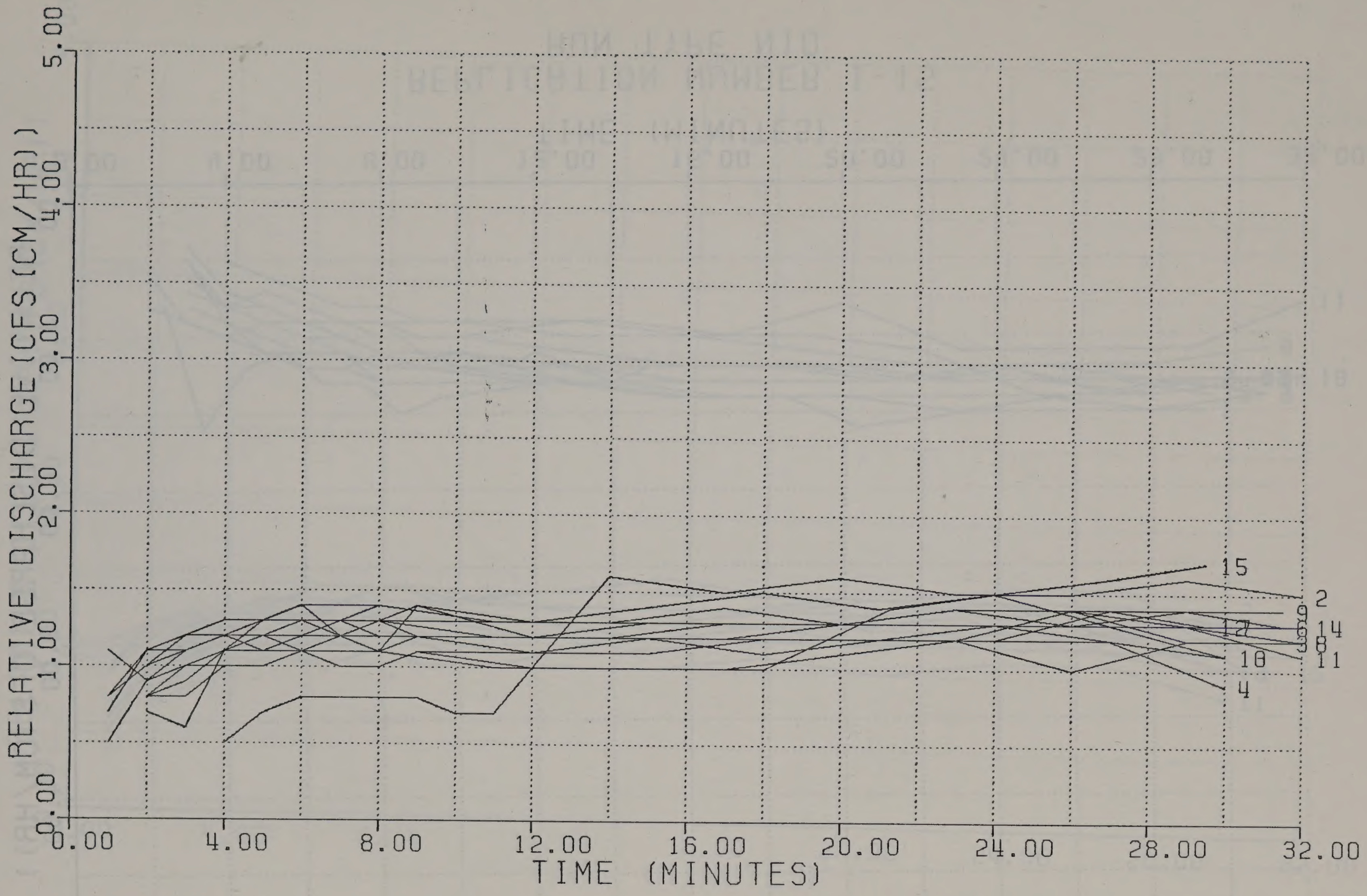
REPLICATION NUMBER 1-15
RUN TYPE B1D



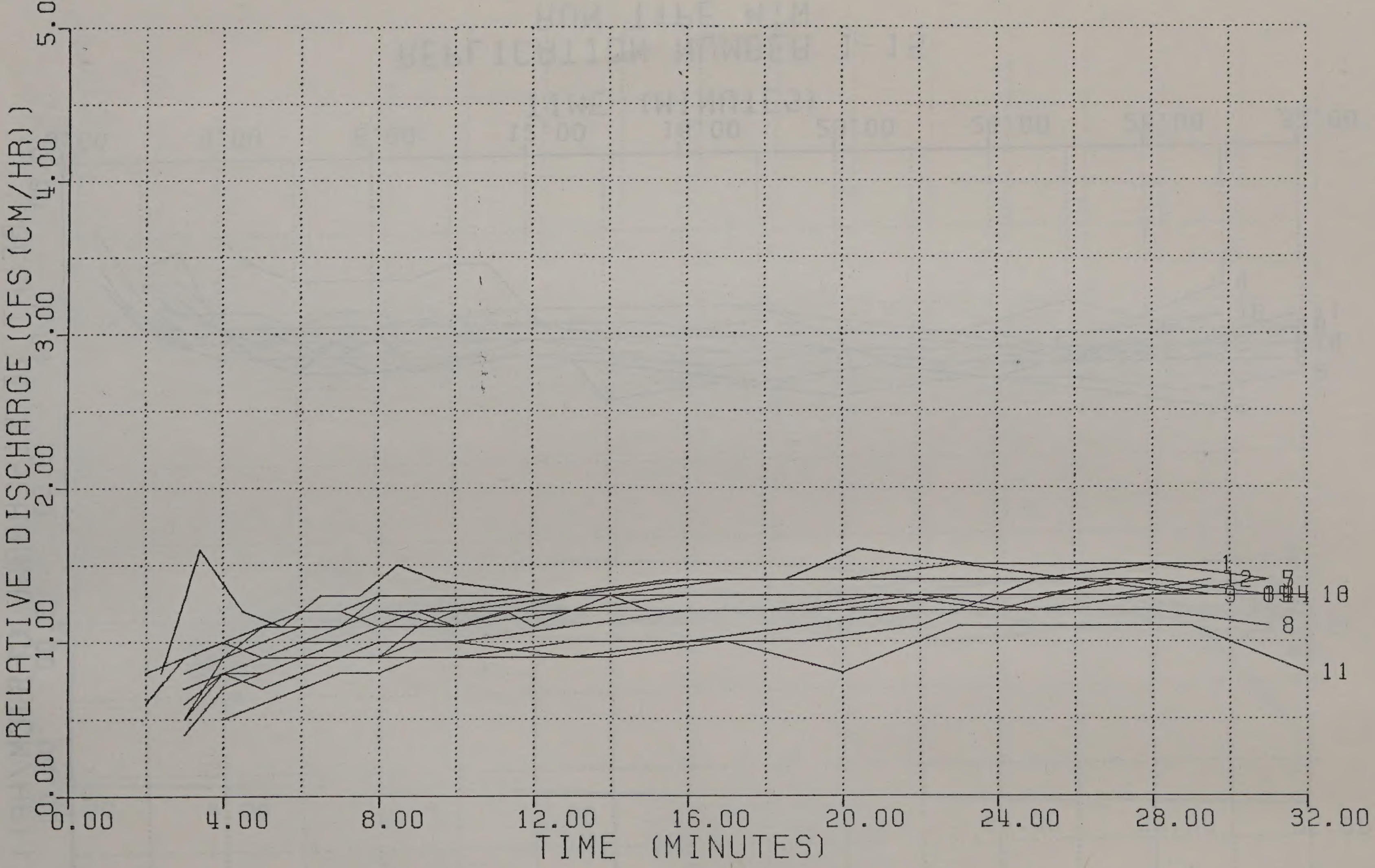
REPLICATION NUMBER 1-15
RUN TYPE B1W



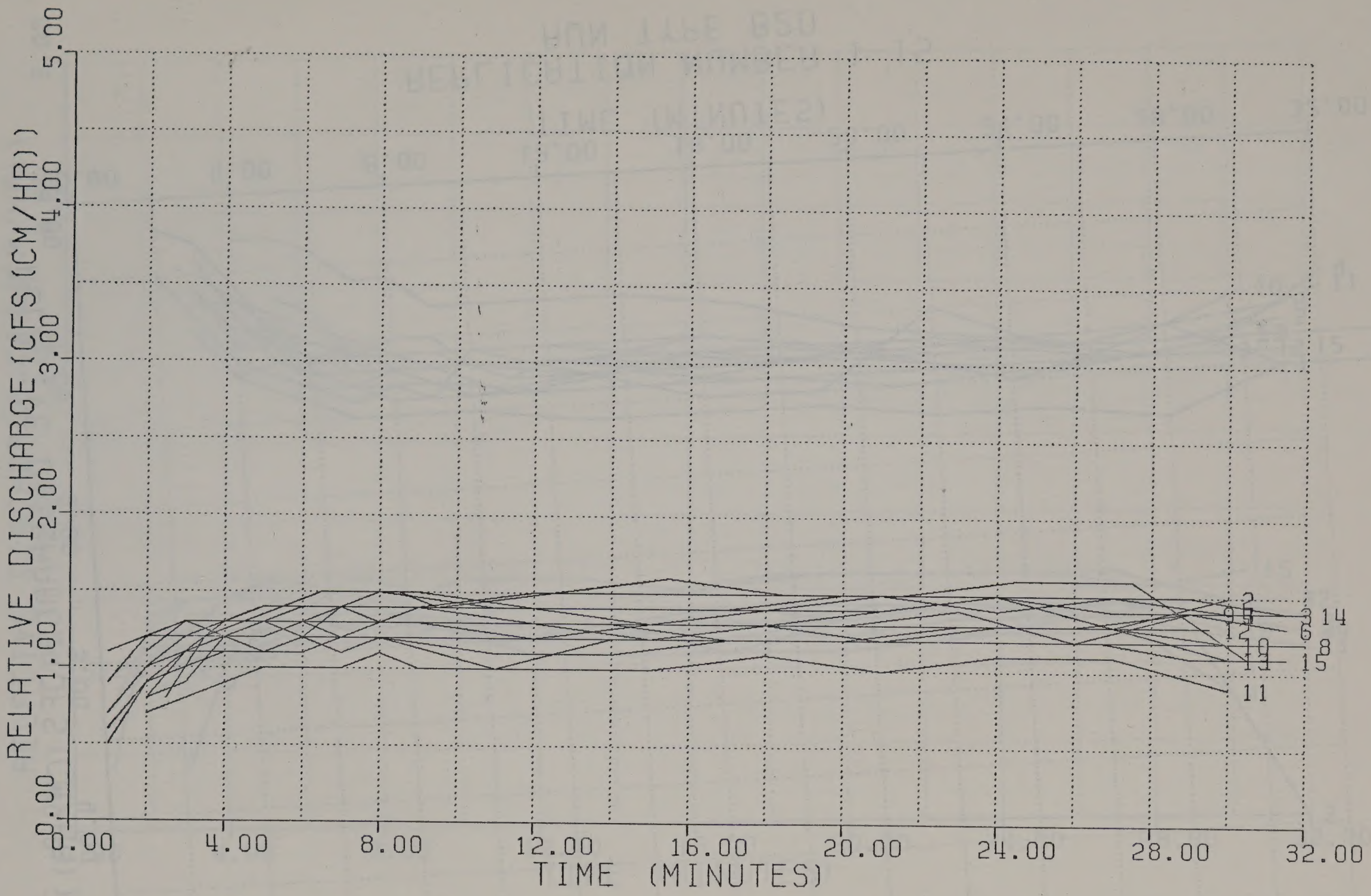
REPLICATIØN NUMBER 1-15
RUN TYPE M1D



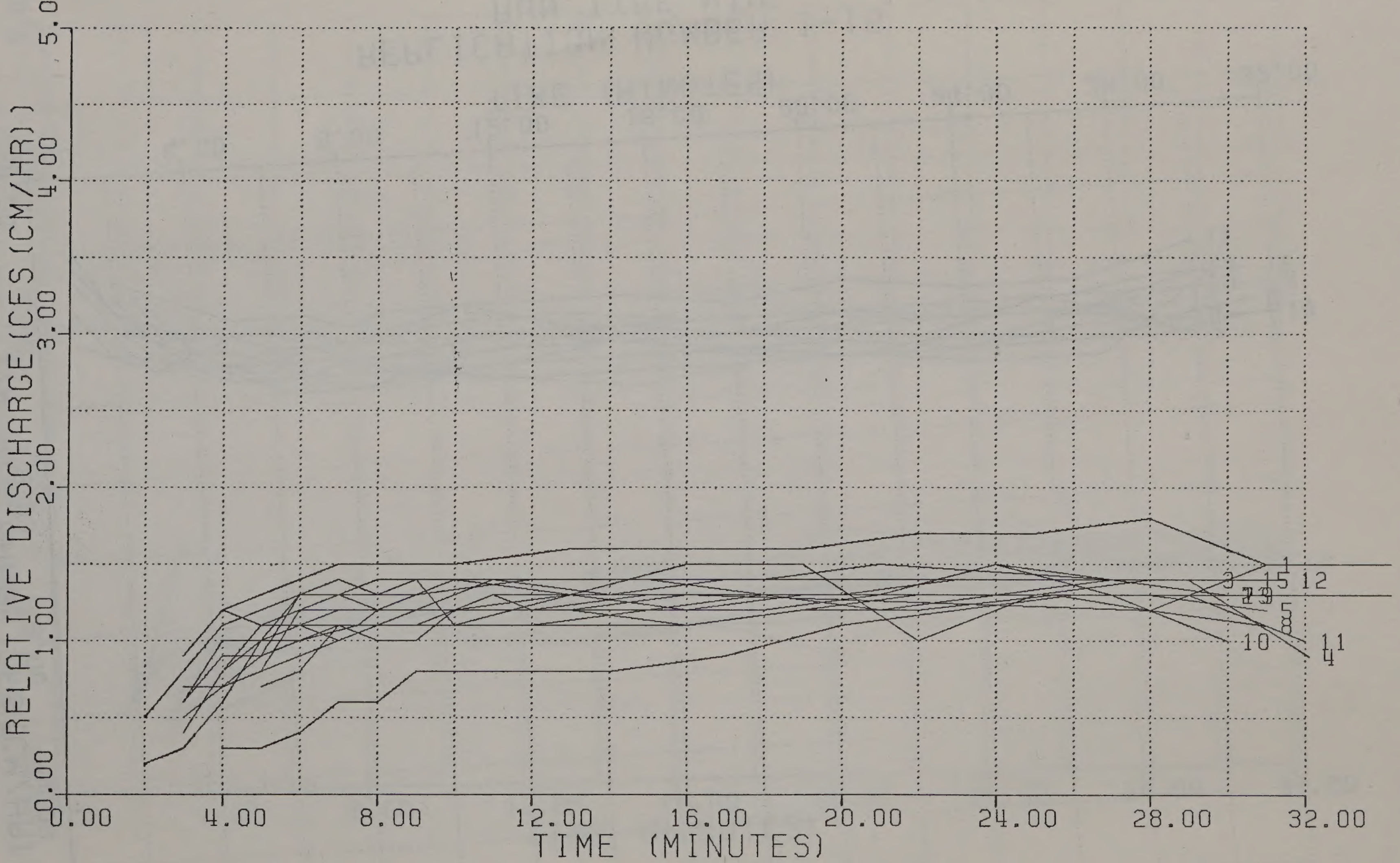
REPLICATION NUMBER 1-15
RUN TYPE M1W



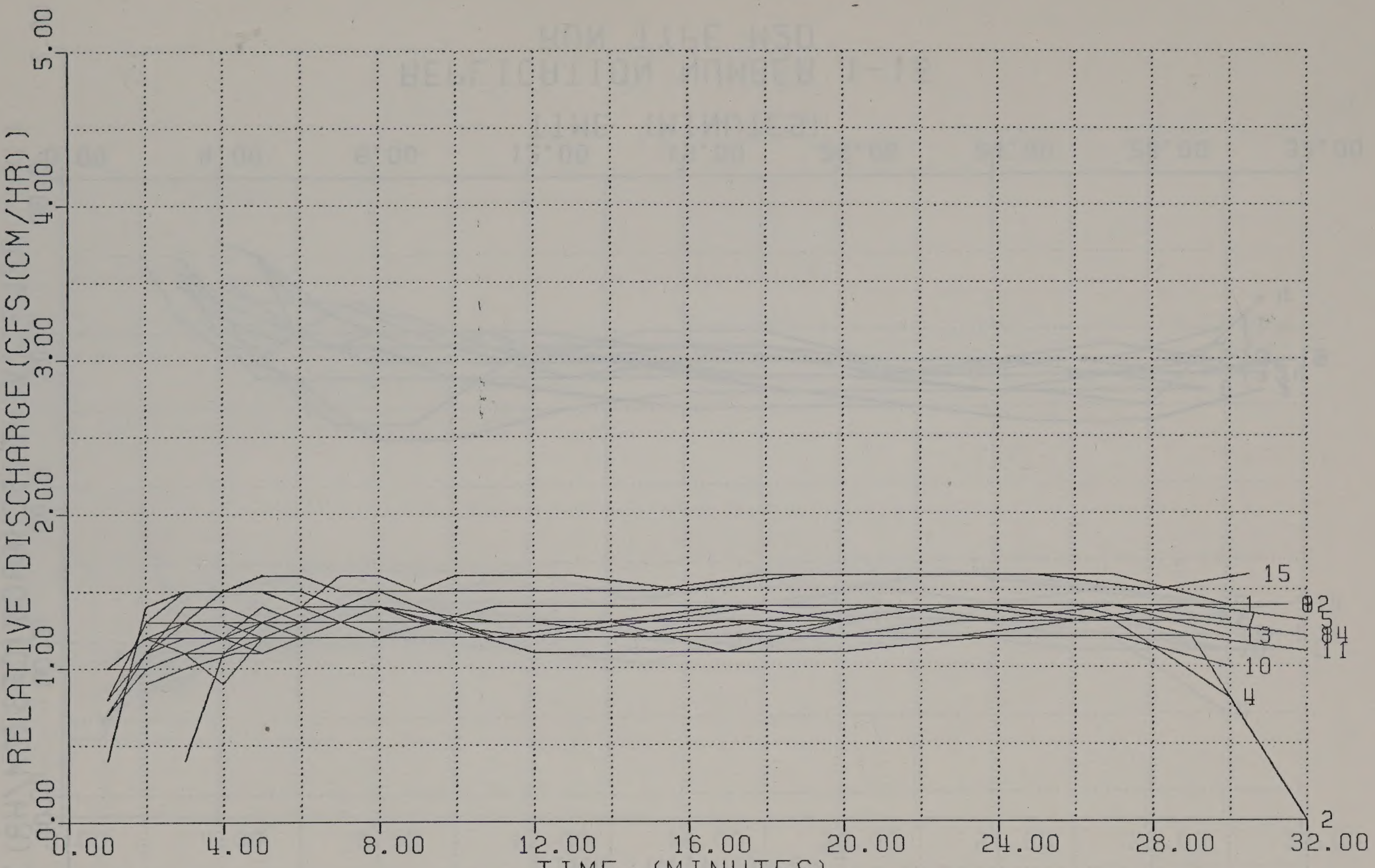
REPLICATION NUMBER 1-15
RUN TYPE N1D



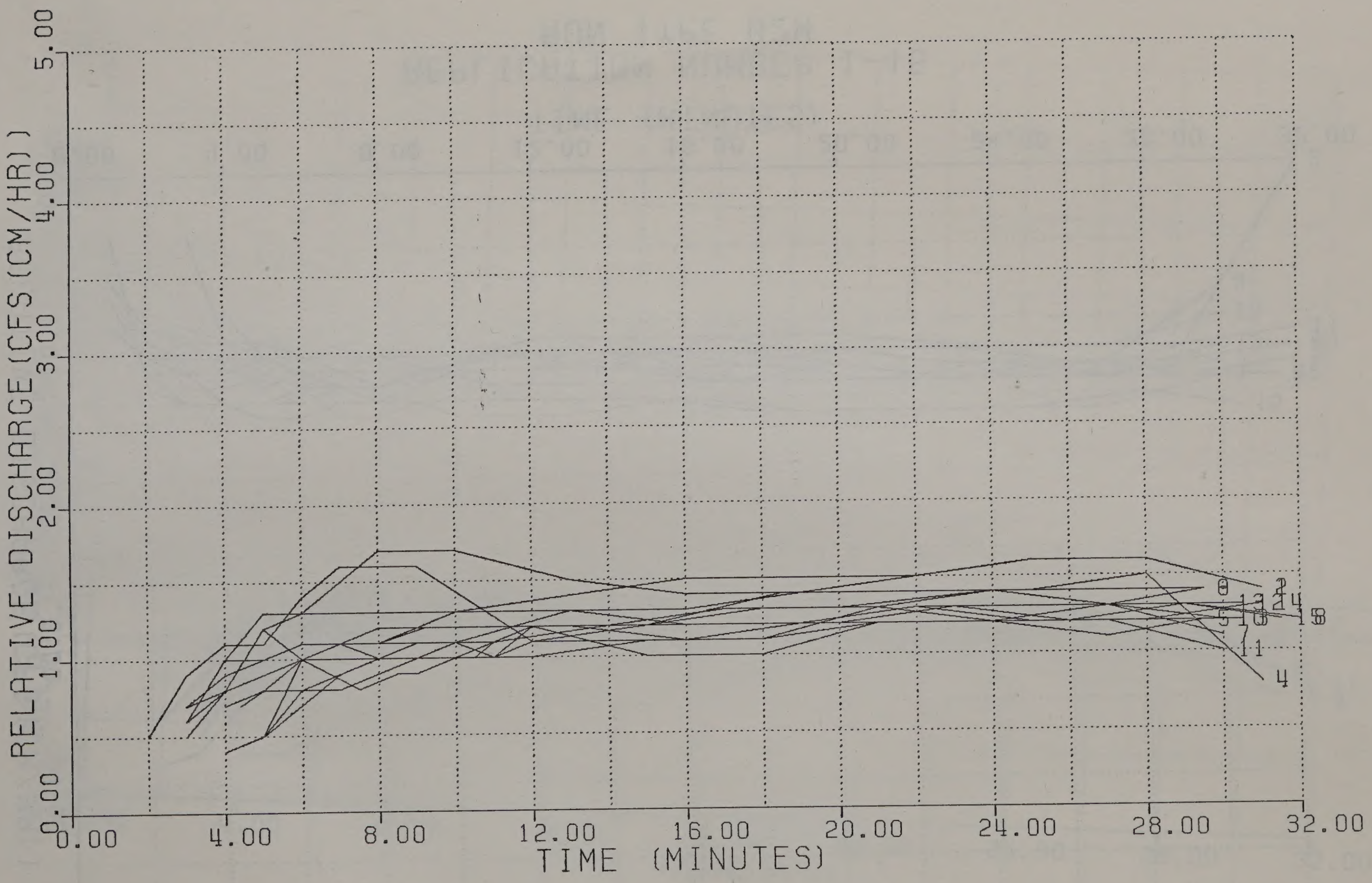
REPLICATION NUMBER 1-15
RUN TYPE N1W



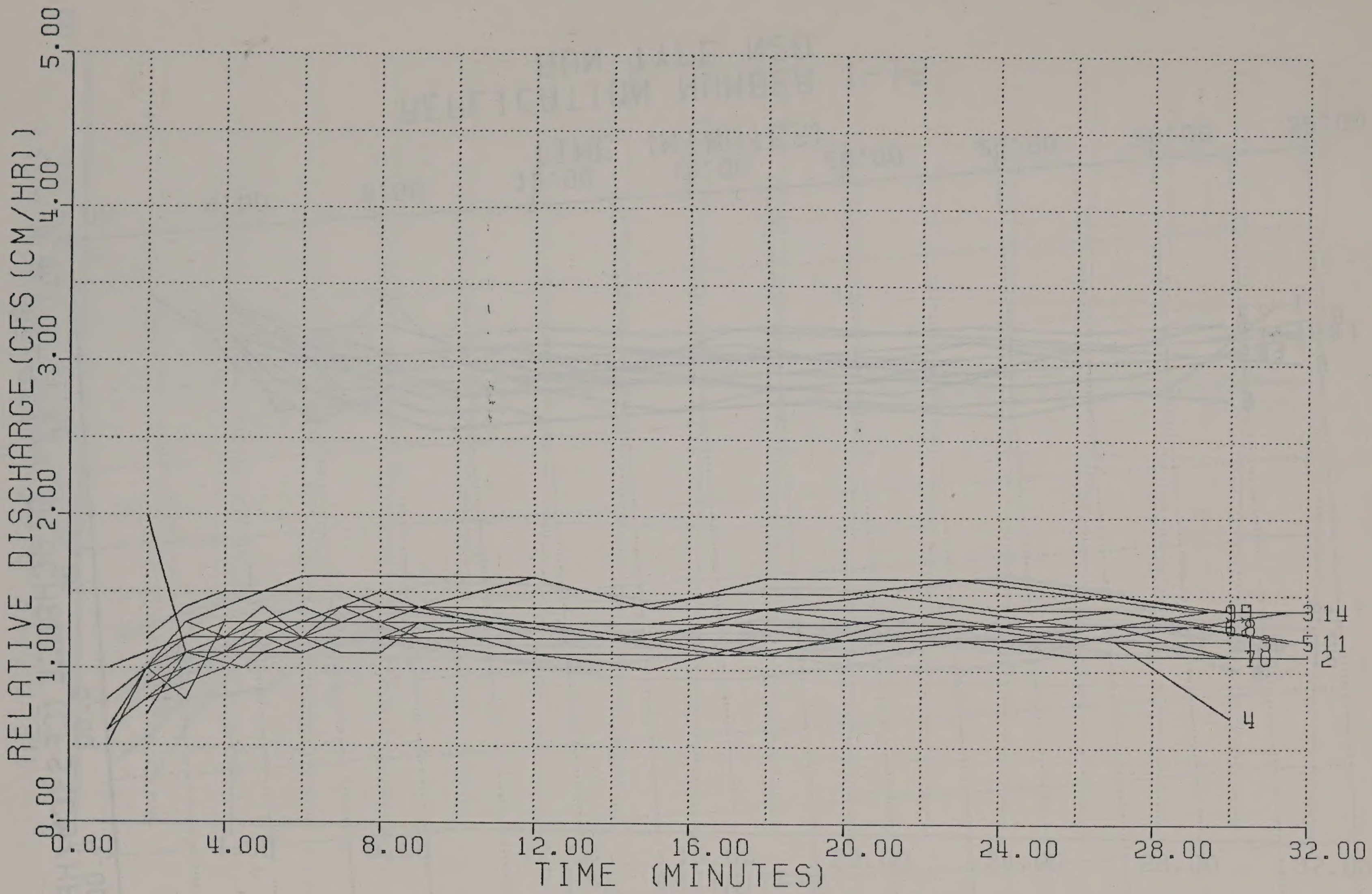
REPLICATION NUMBER 1-15
RUN TYPE B2D



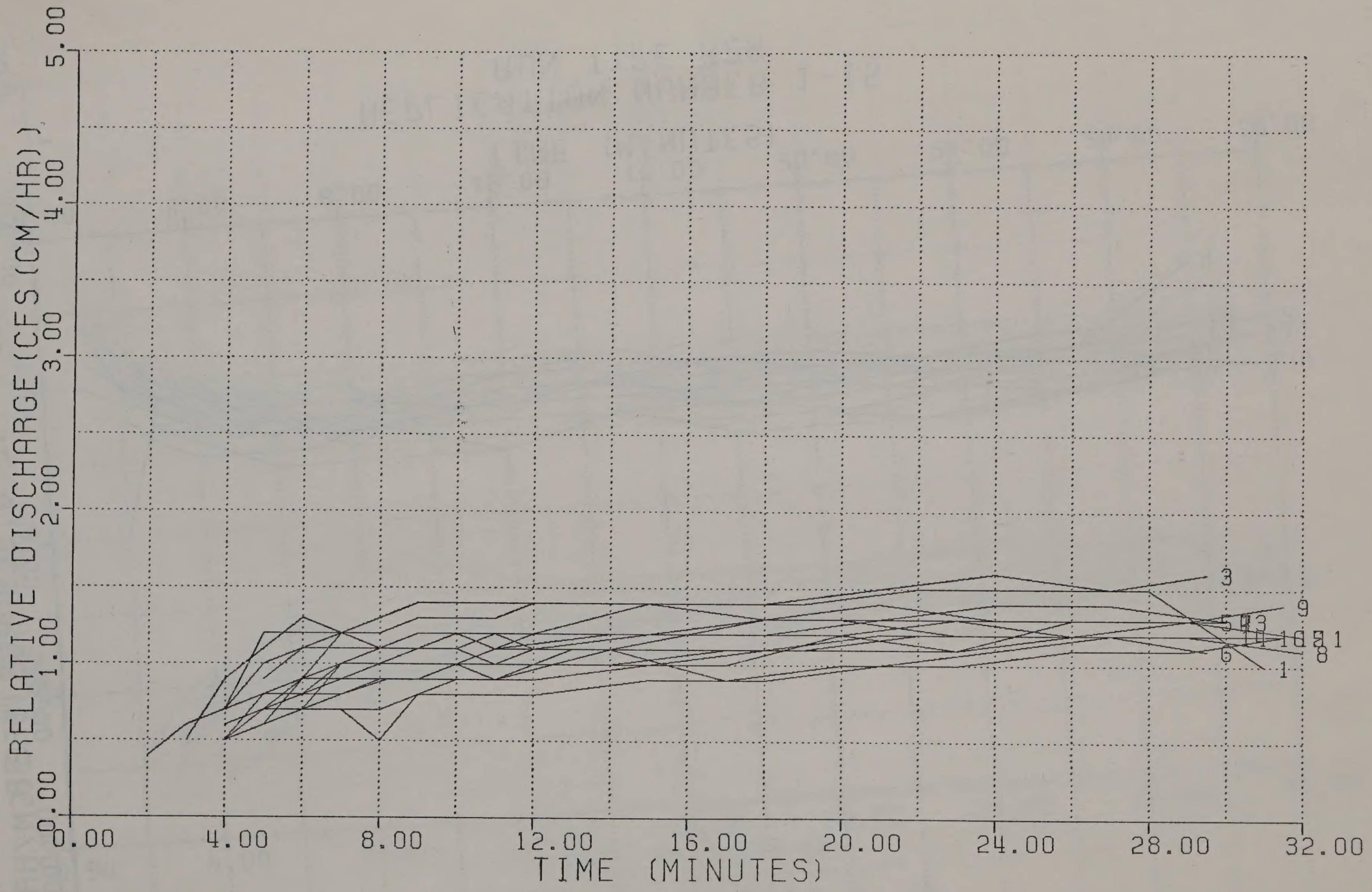
REPLICATION NUMBER 1-15
RUN TYPE B2W



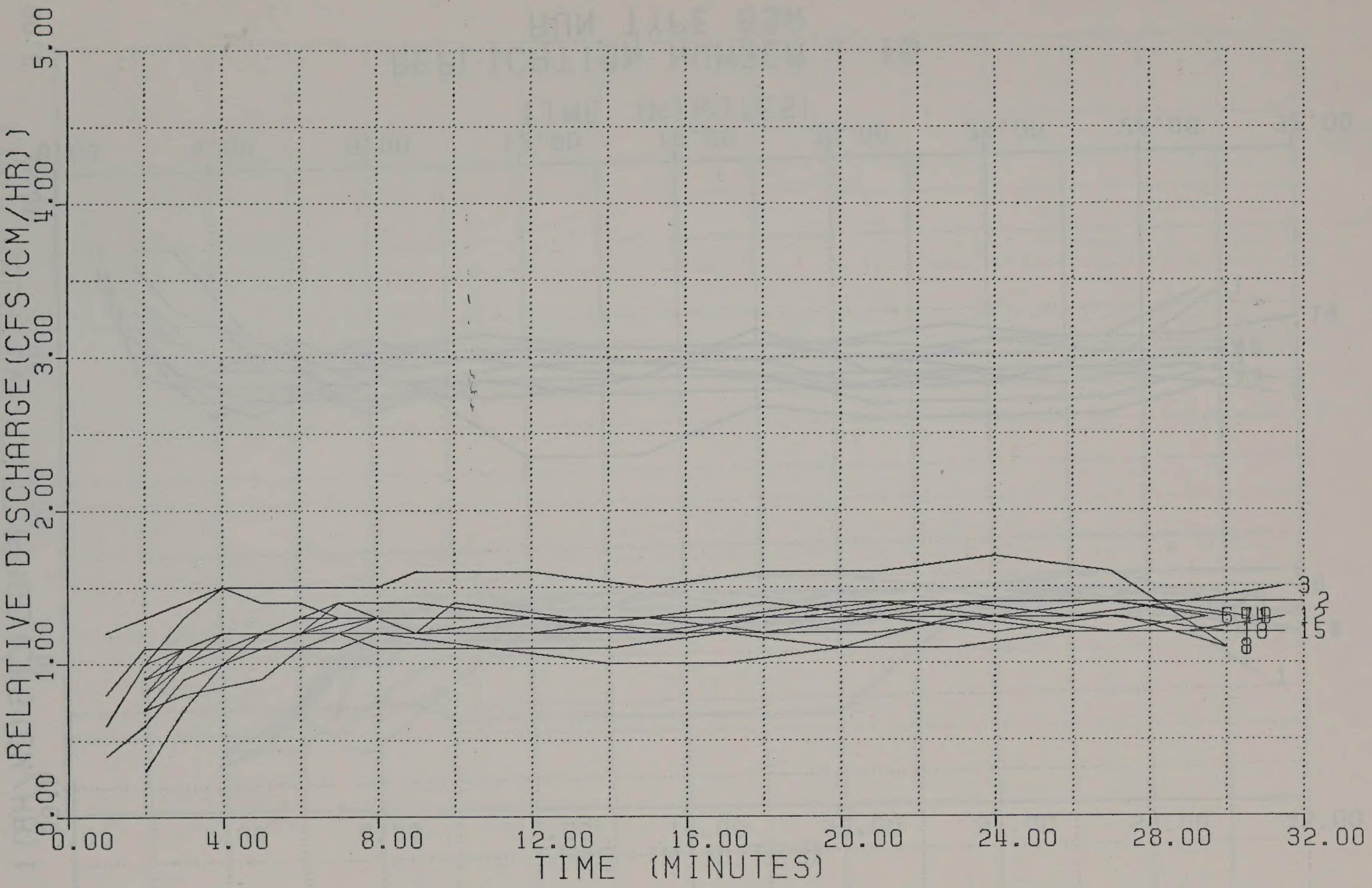
REPLICATION NUMBER 1-15
RUN TYPE M2D



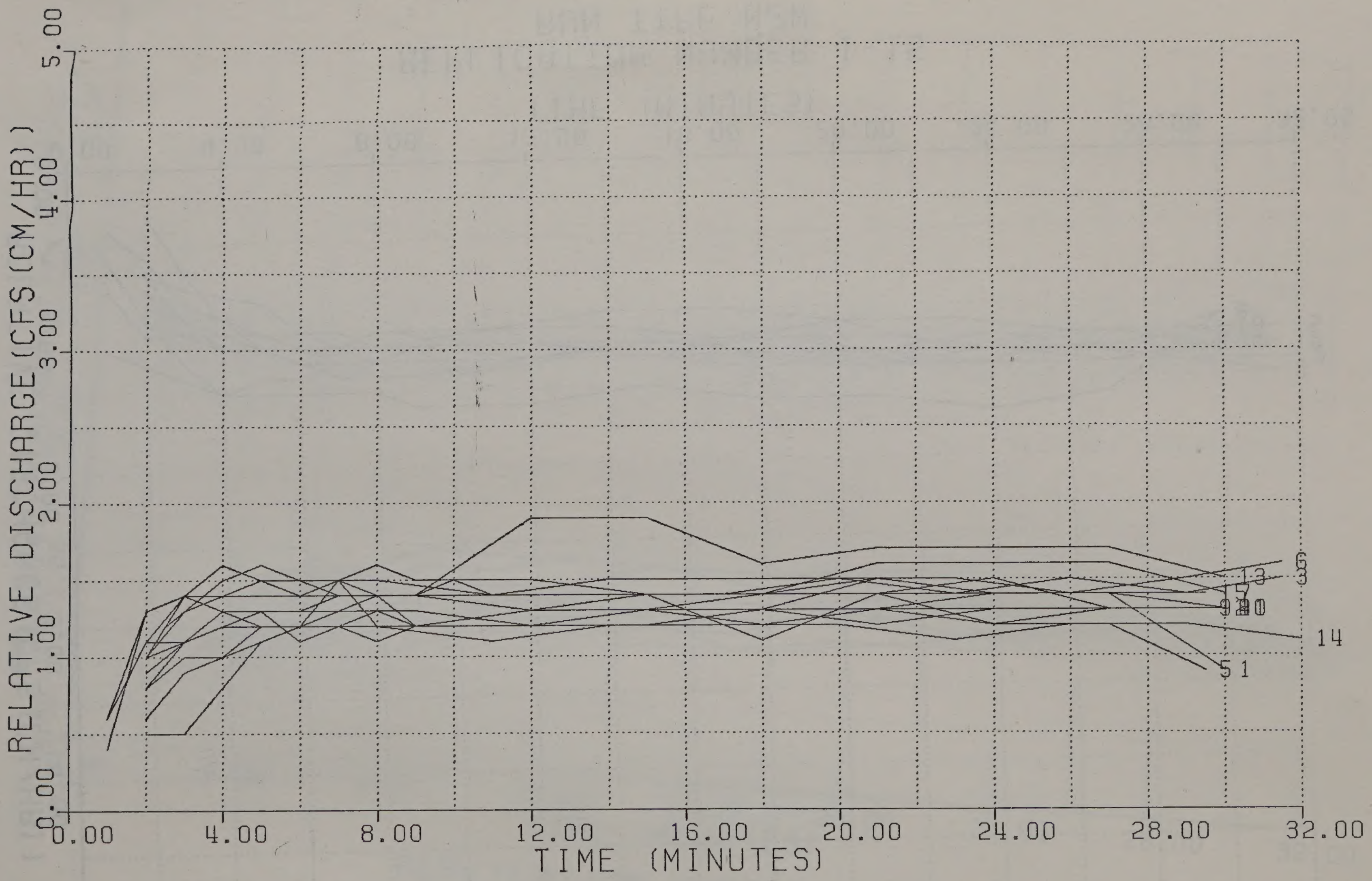
REPLICATION NUMBER 1-15
RUN TYPE M2W



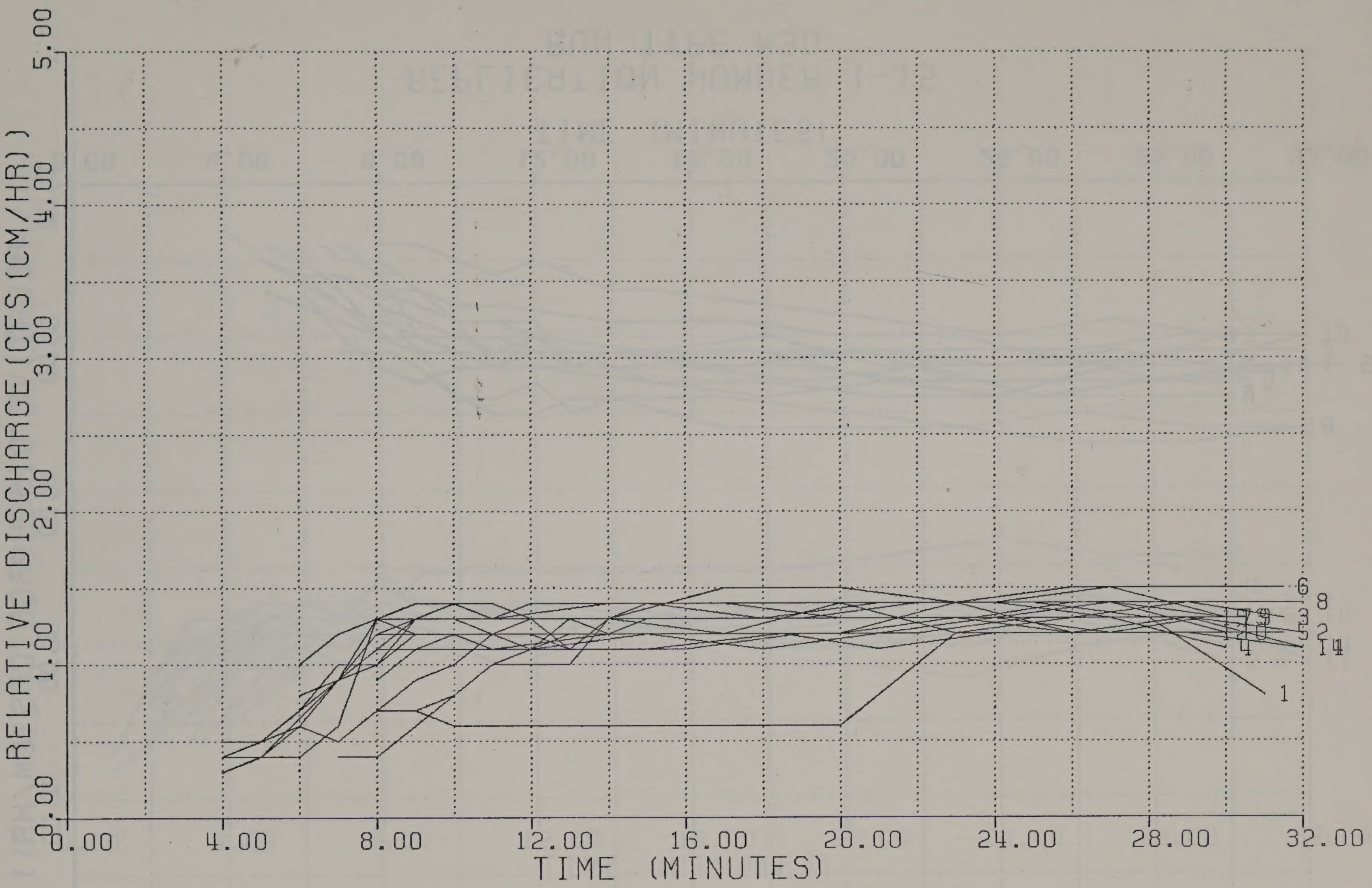
REPLICATION NUMBER 1-15
RUN TYPE N2D



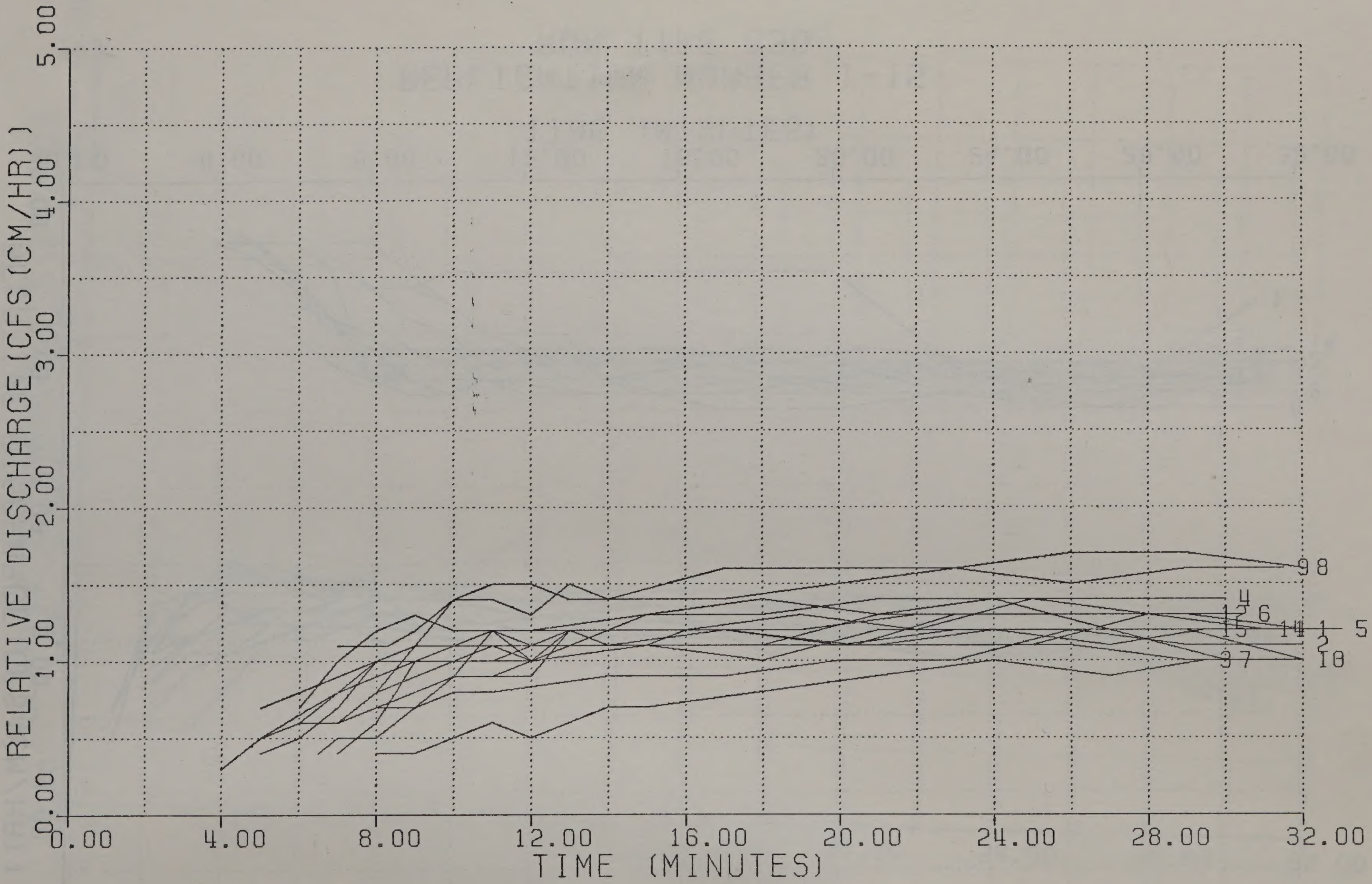
REPLICATIØN NUMBER 1-15
RUN TYPE N2W



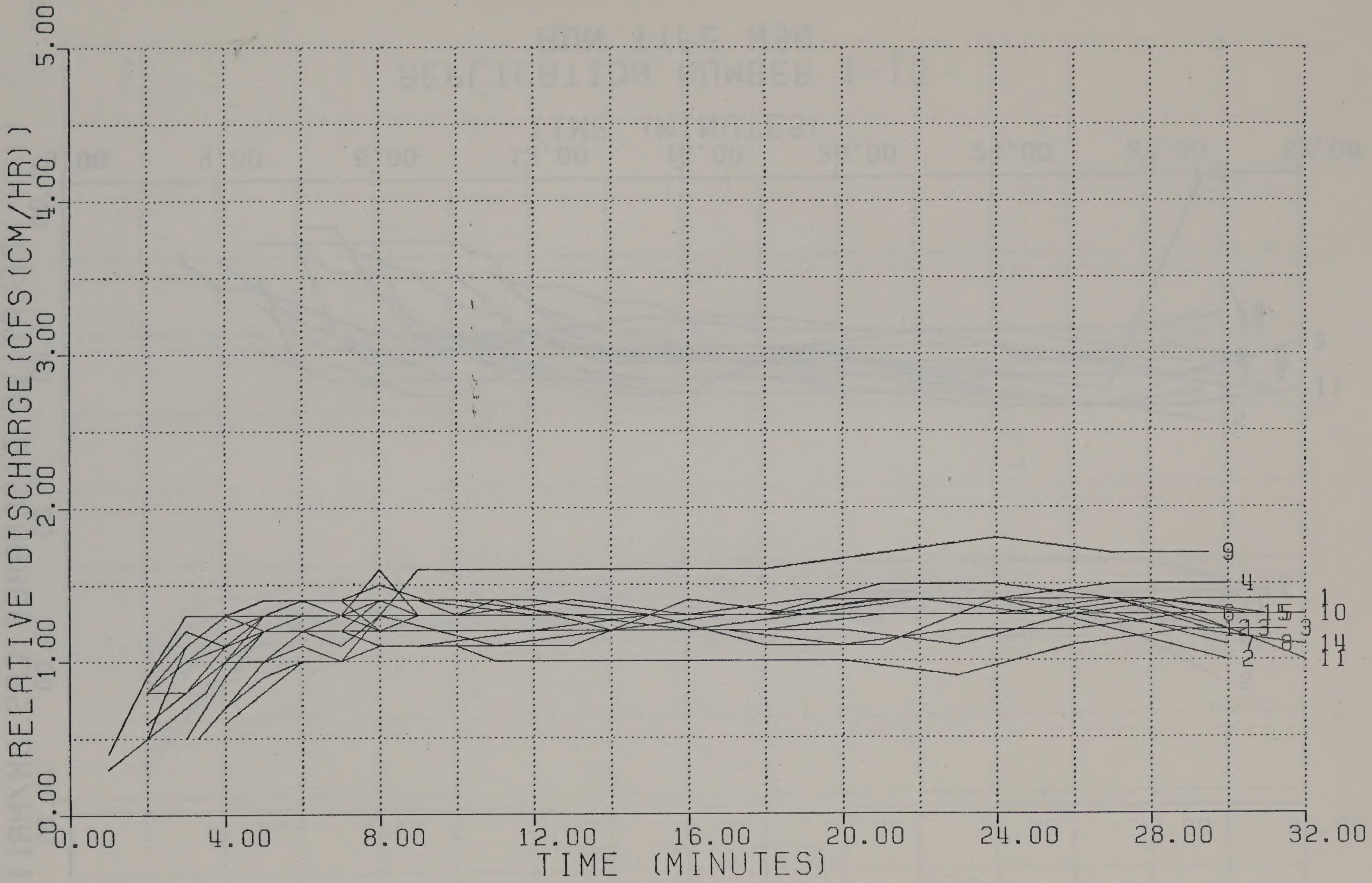
REPLICATIØN NUMBER 1-15
RUN TYPE B3W



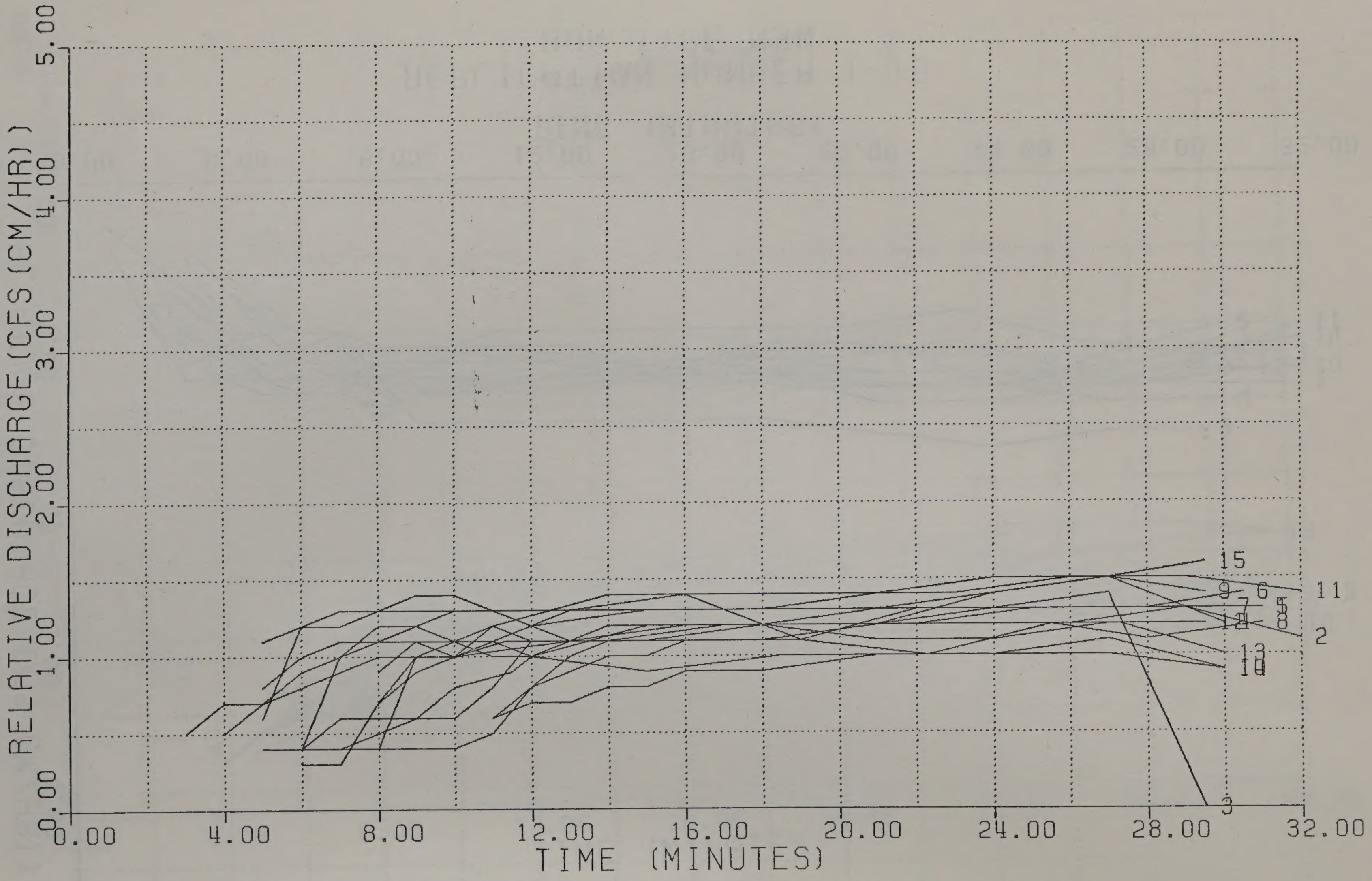
REPLICATION NUMBER 1-15
RUN TYPE B3D



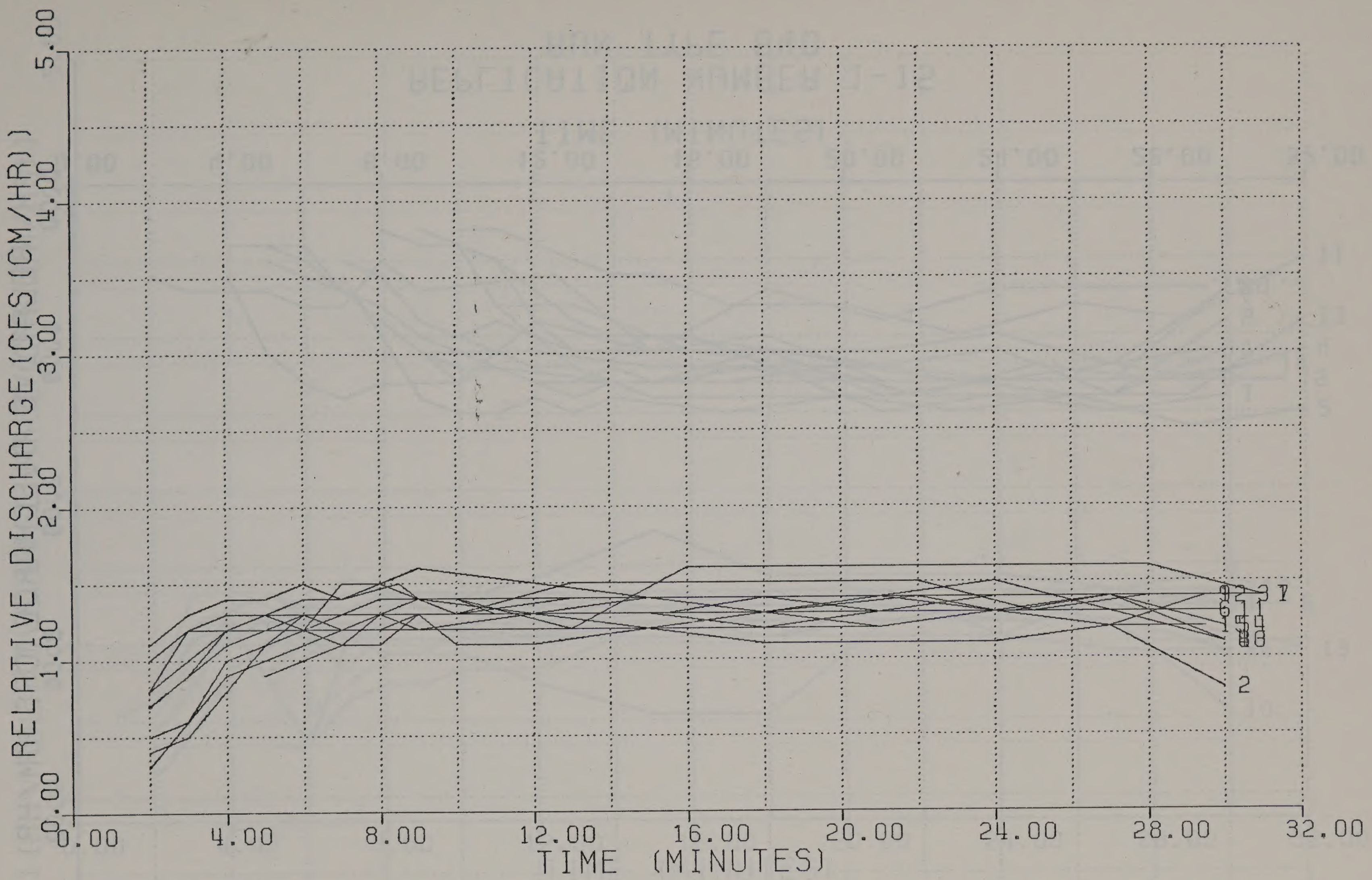
REPLICATION NUMBER 1-15
RUN TYPE M3D



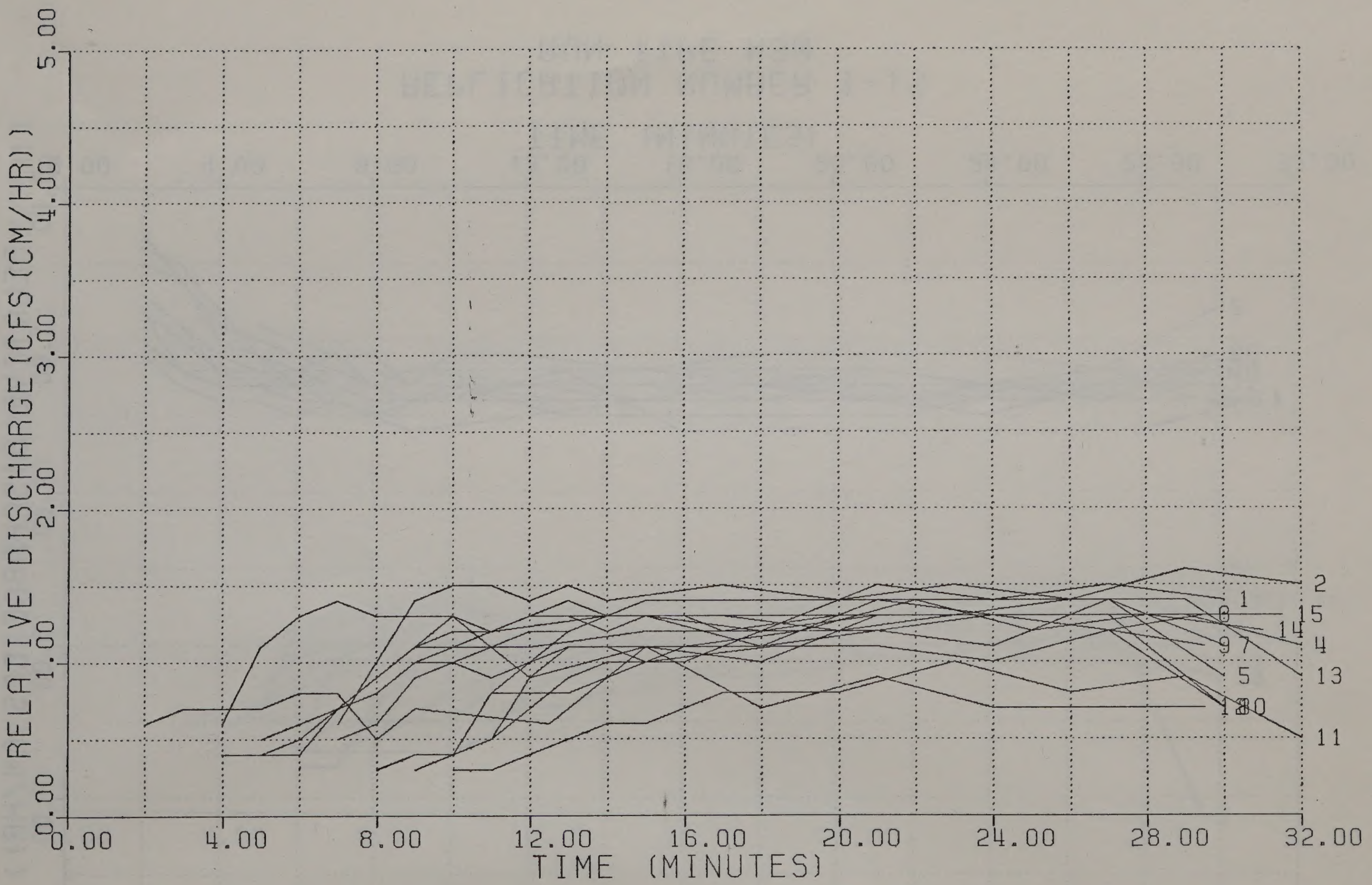
REPLICATION NUMBER 1-15
RUN TYPE M3W



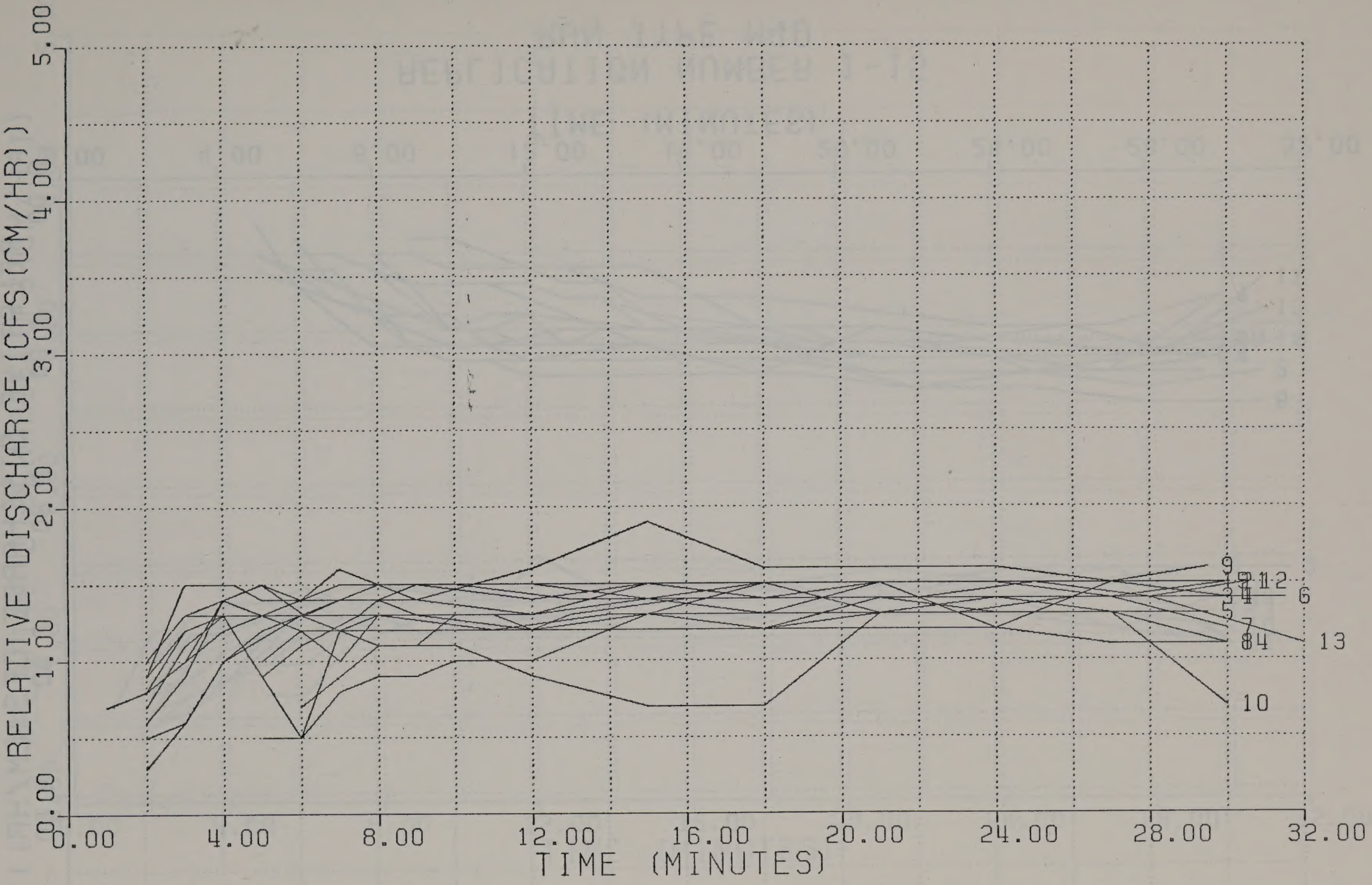
REPLICATION NUMBER 1-15
RUN TYPE N3D



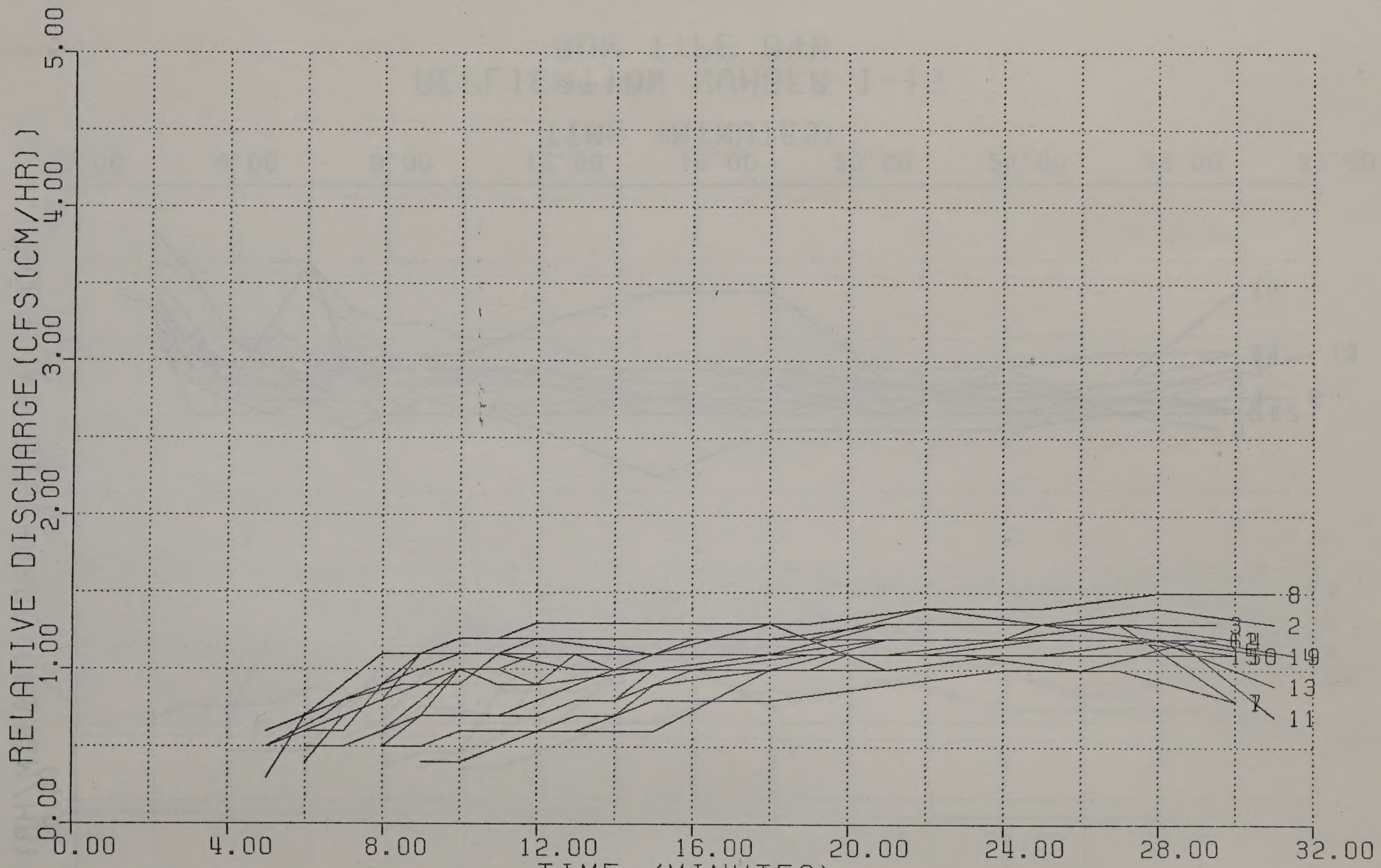
REPLICATION NUMBER 1-15
RUN TYPE N3W



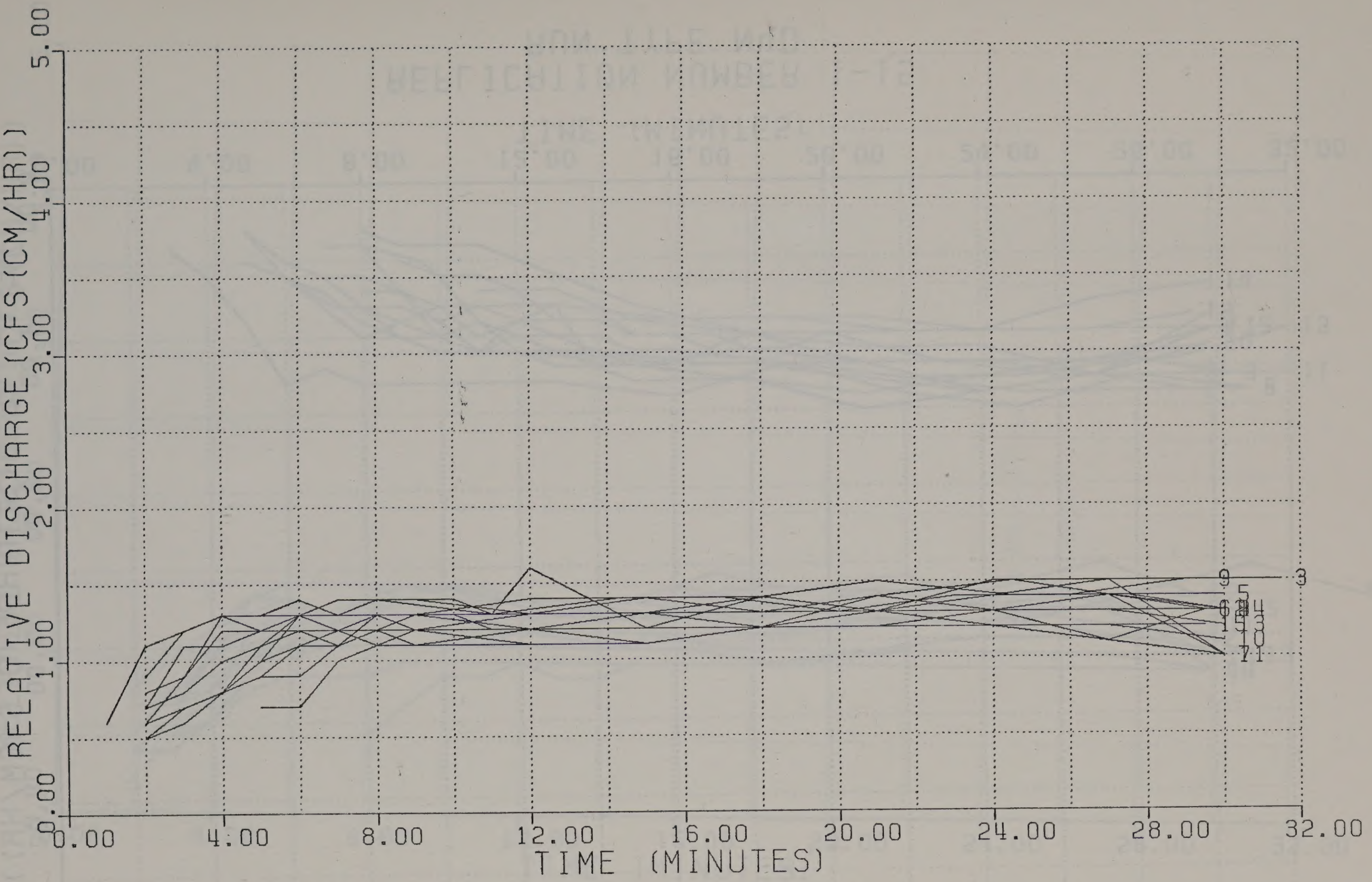
REPLICATION NUMBER 1-15
RUN TYPE B4D



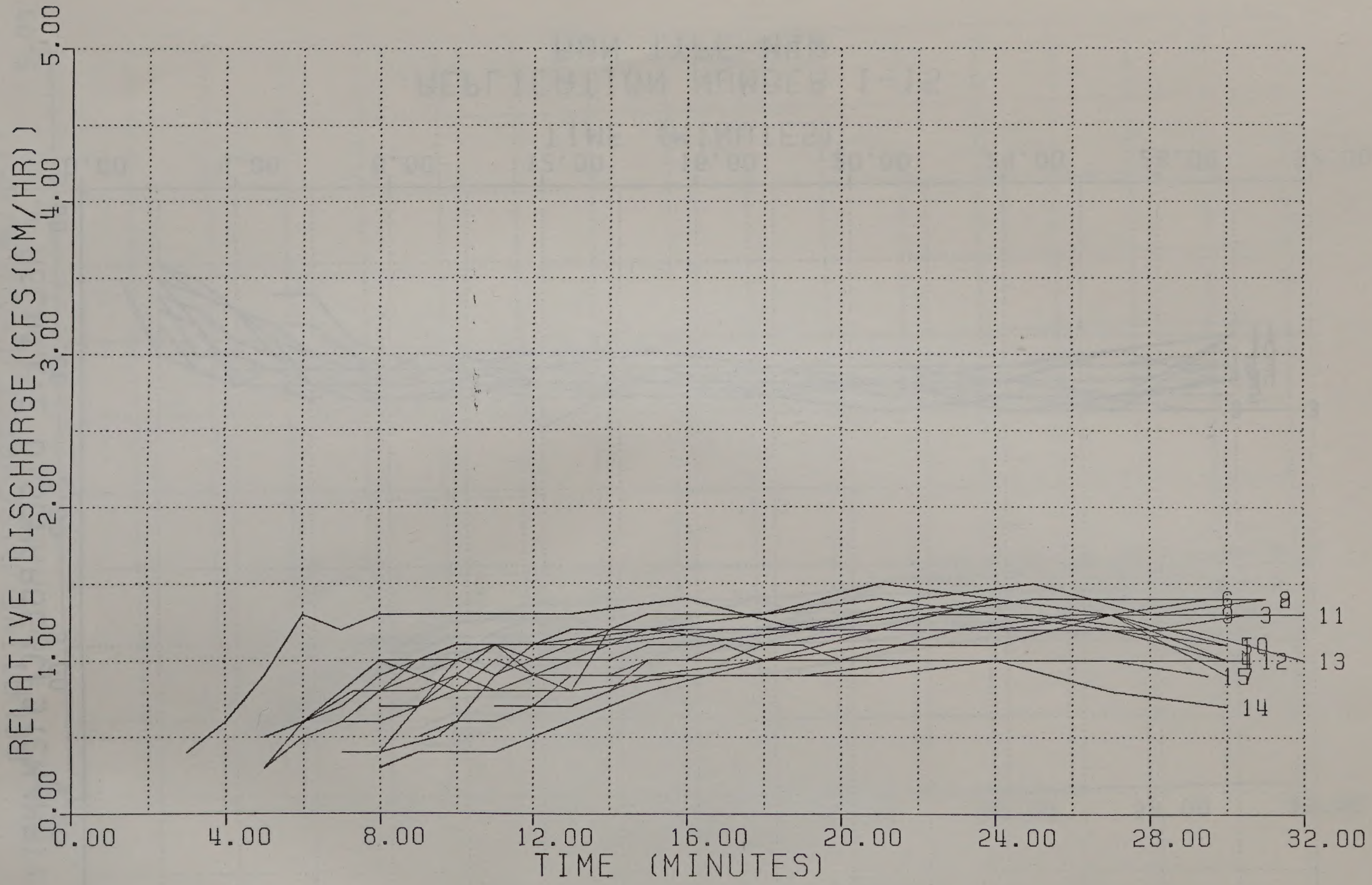
REPLICATION NUMBER 1-15
RUN TYPE B4W.



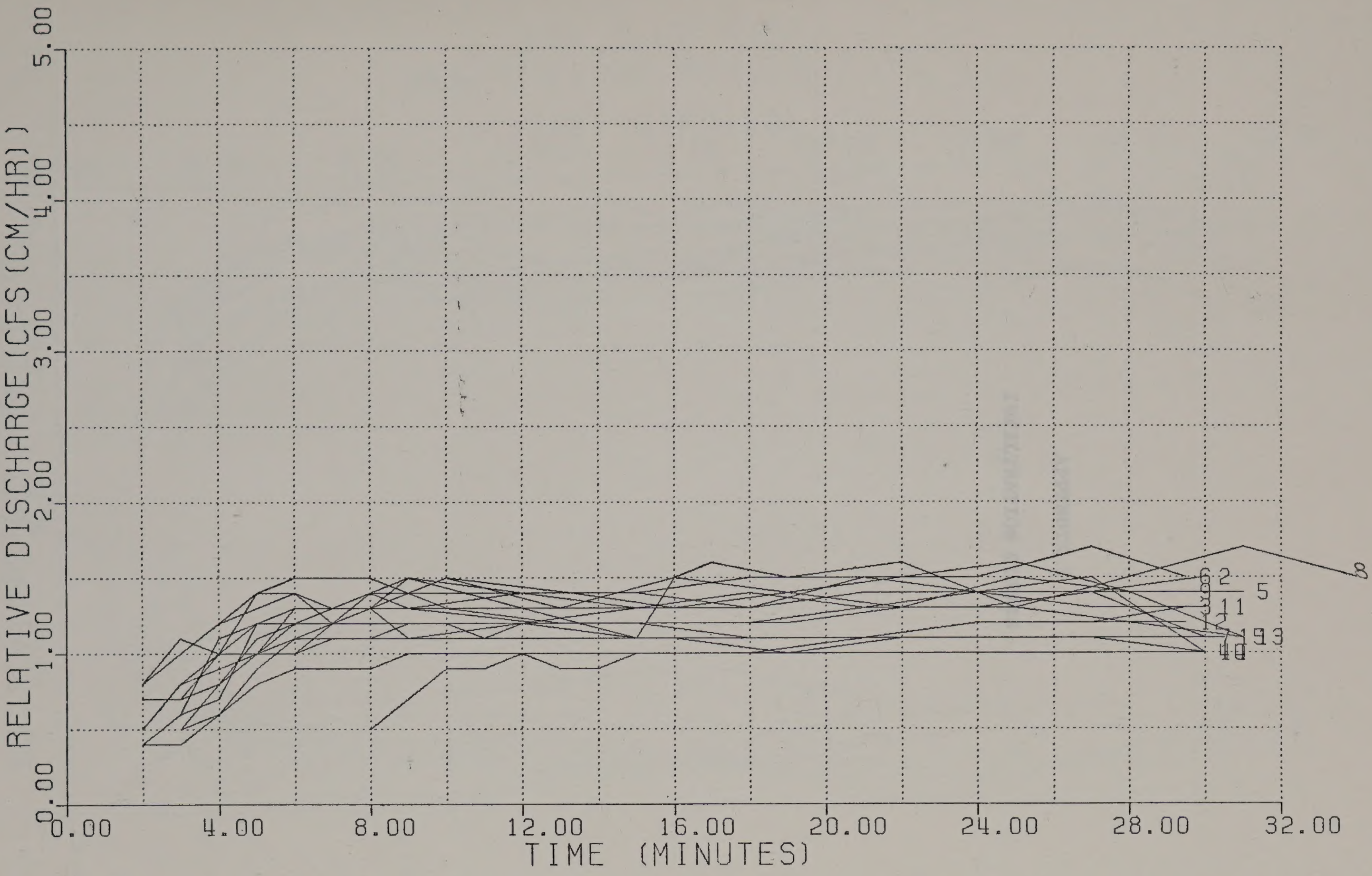
REPLICATION NUMBER 1-15
RUN TYPE M4D



REPLICATION NUMBER 1-15
RUN TYPE M4W



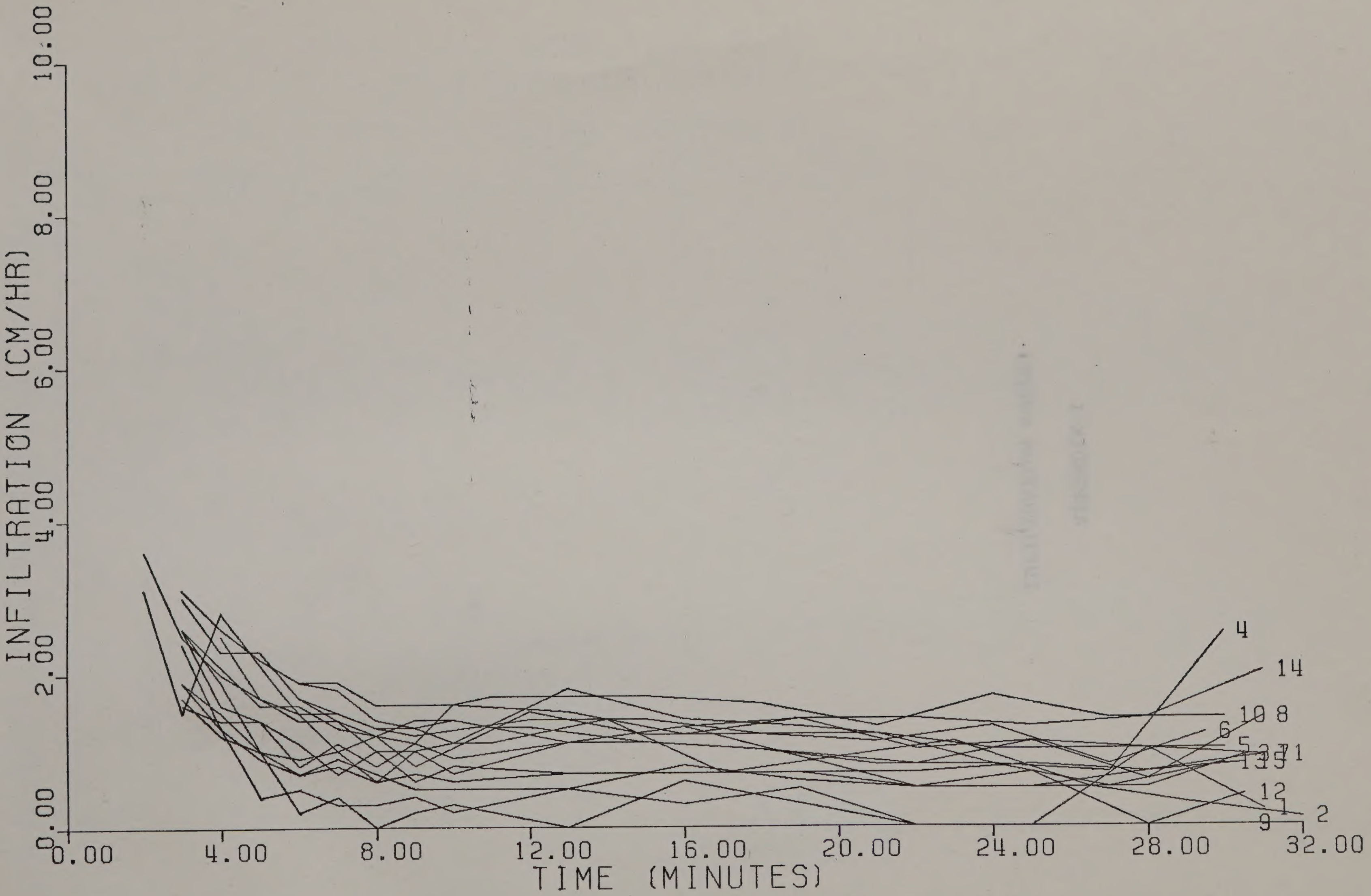
REPLICATION NUMBER 1-15
RUN TYPE N4D



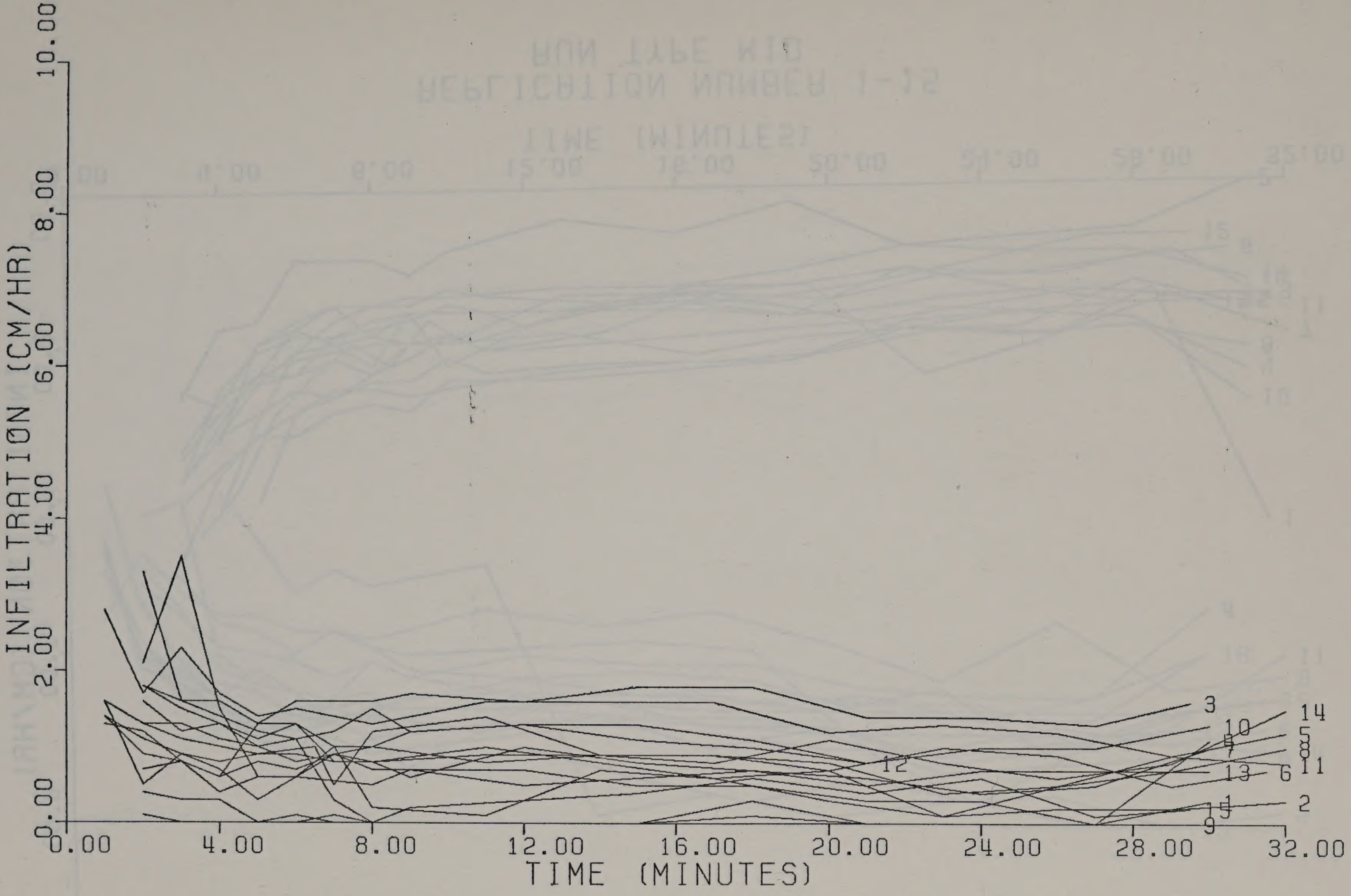
REPLICATIØN NUMBER 1-15
RUN TYPE N4W

APPENDIX I

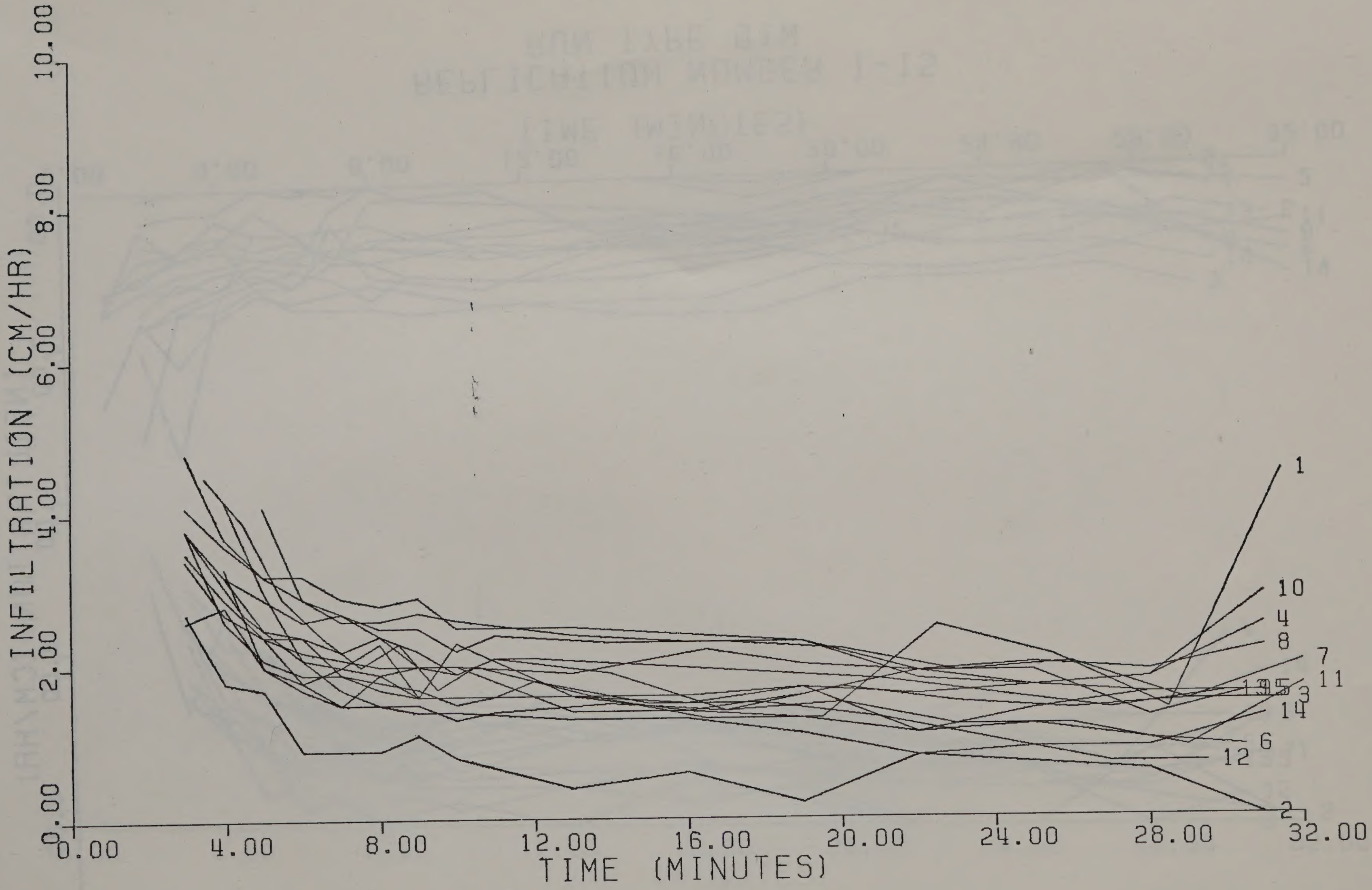
INFILTRATION CURVES



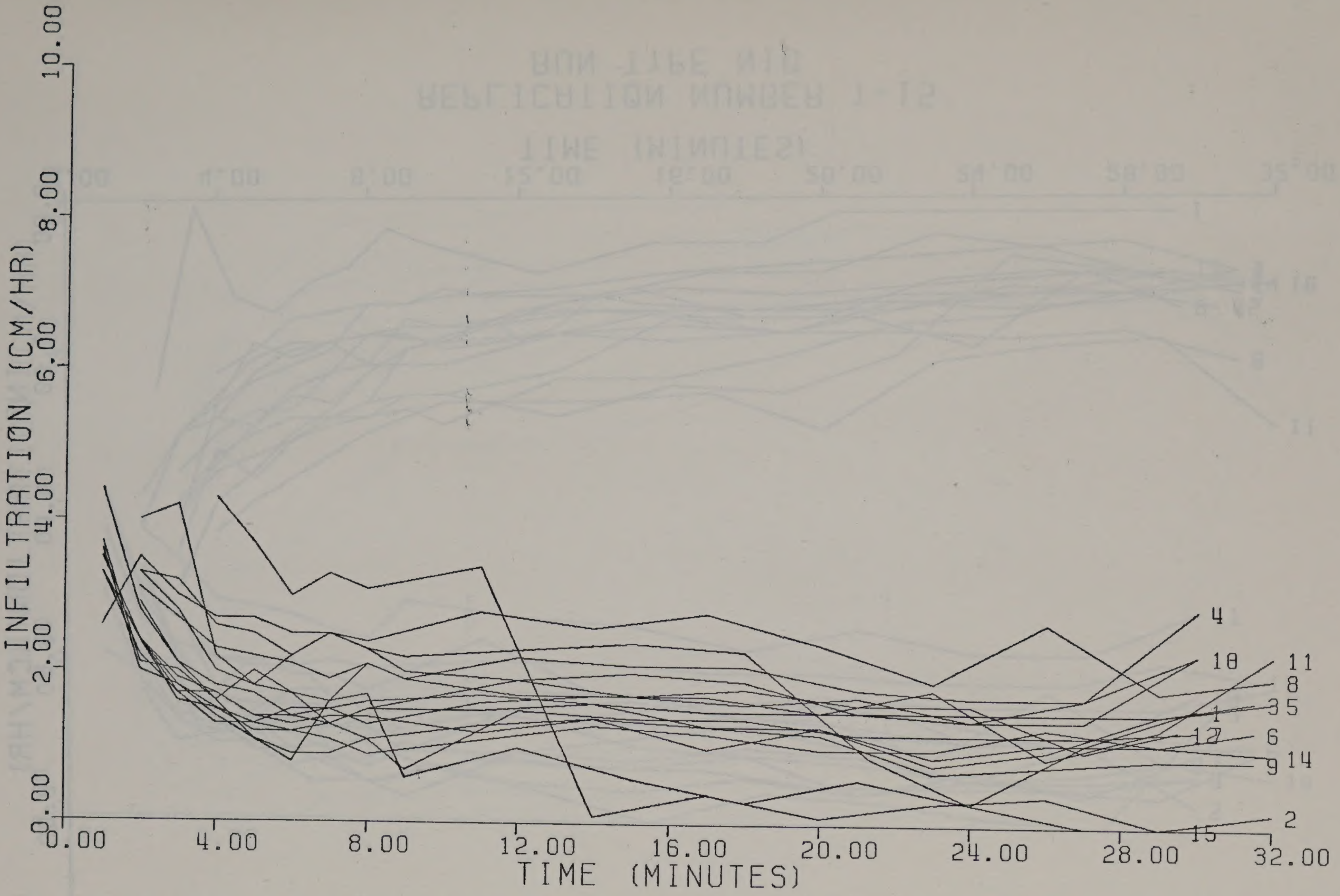
REPLICATION NUMBER 1-15
RUN TYPE B1D



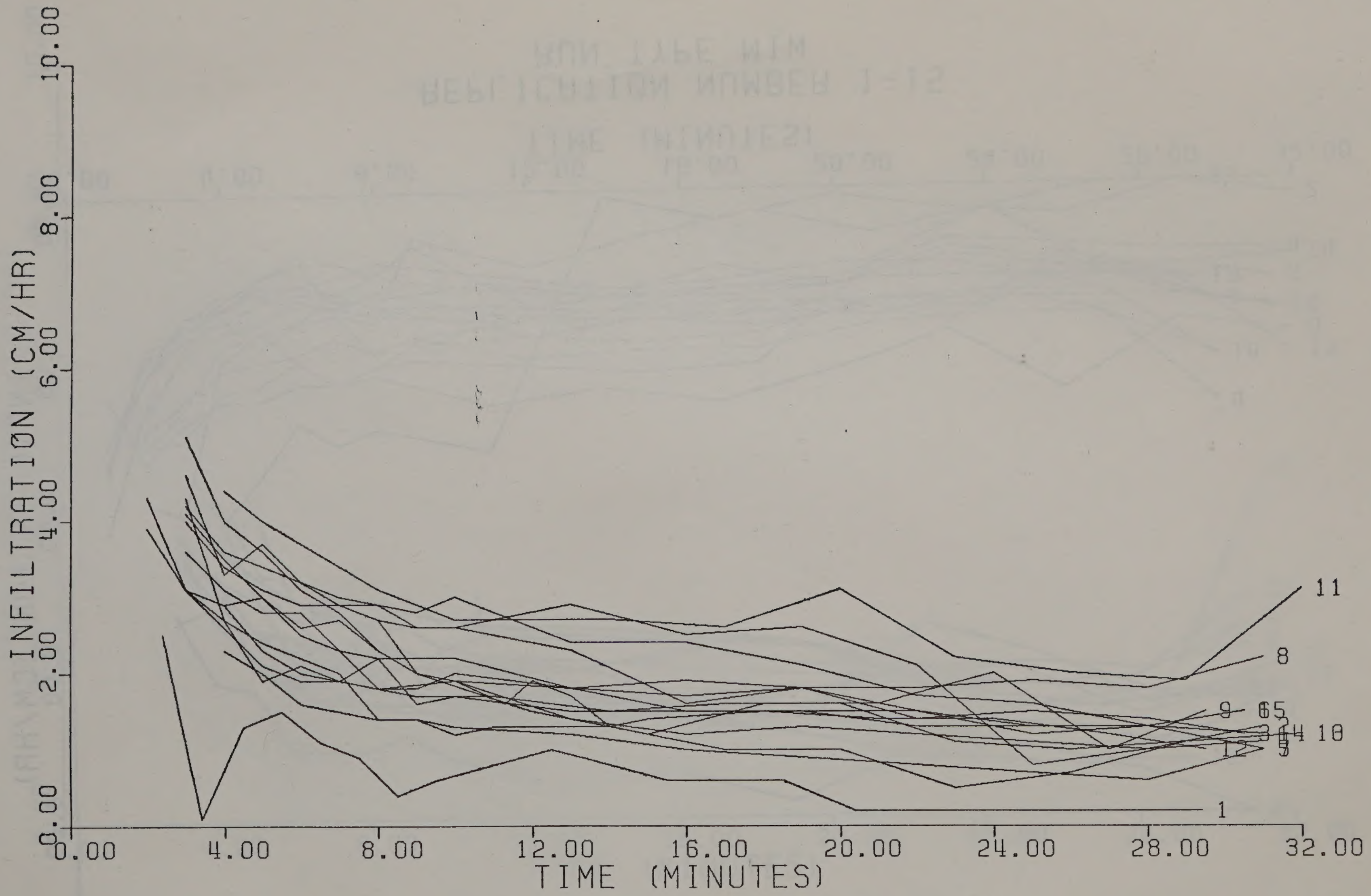
REPLICATION NUMBER 1-15
RUN TYPE B1W



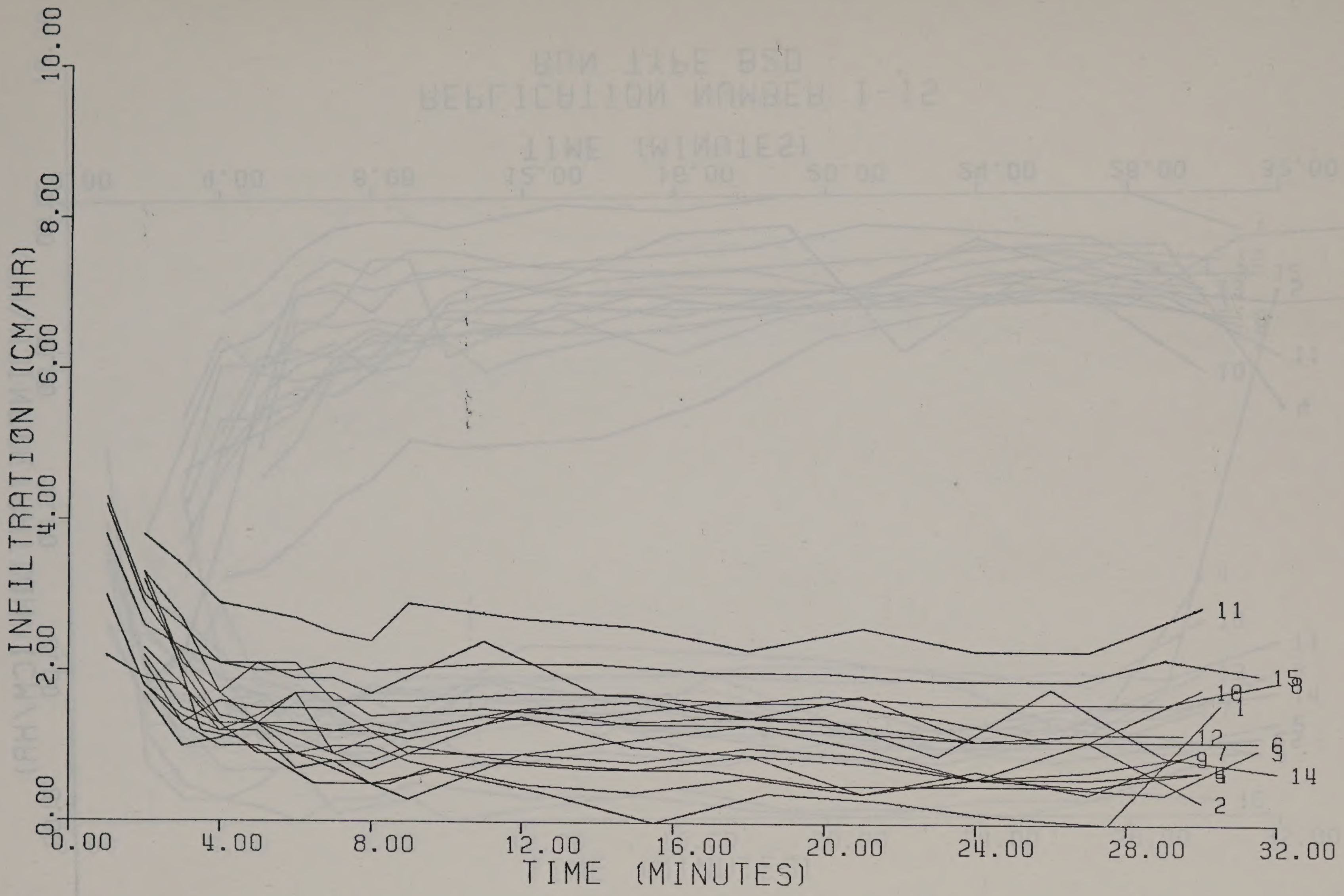
REPLICATION NUMBER 1-15
RUN TYPE M1D



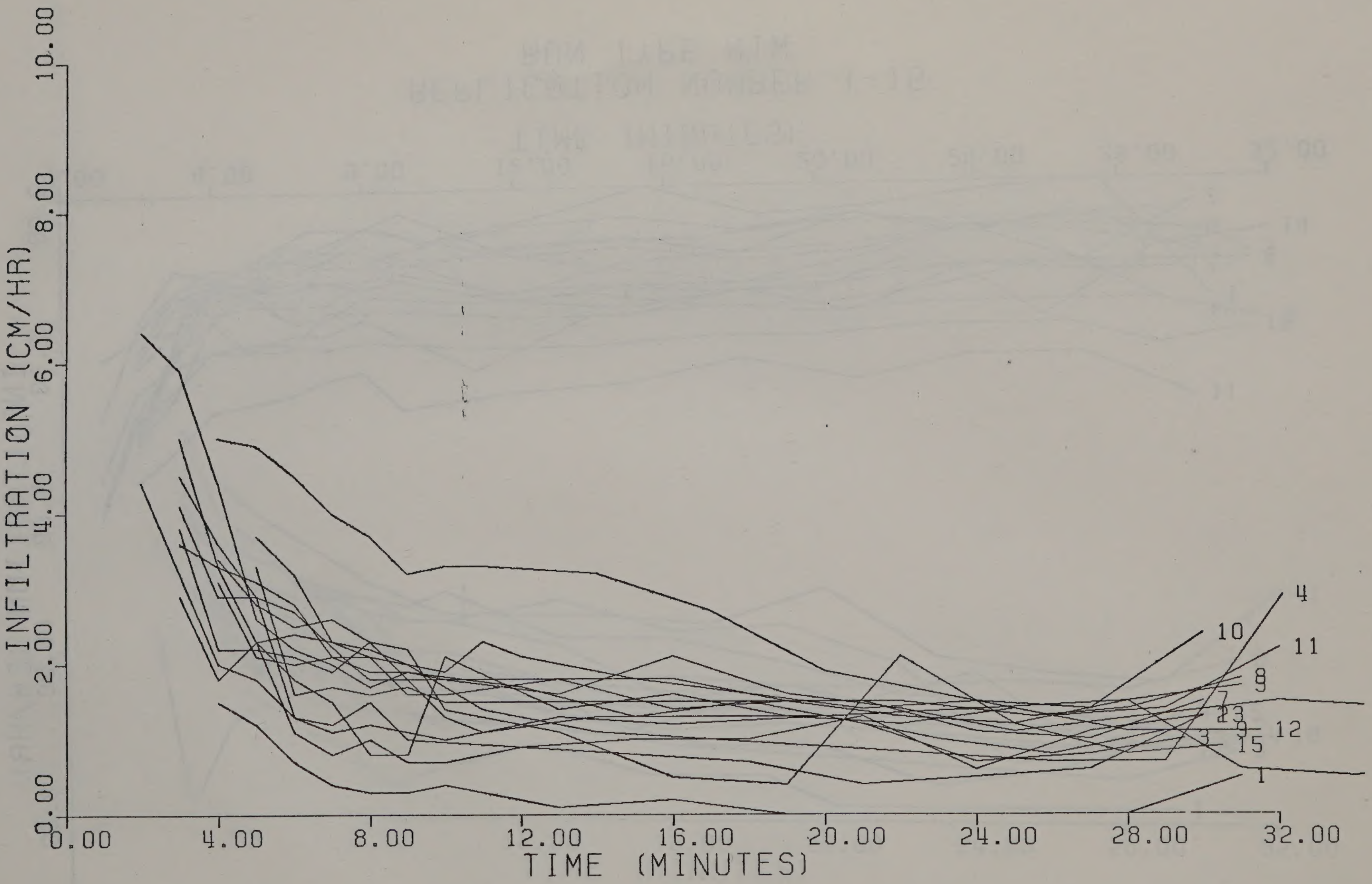
REPLICATION NUMBER 1-15
RUN TYPE M1W



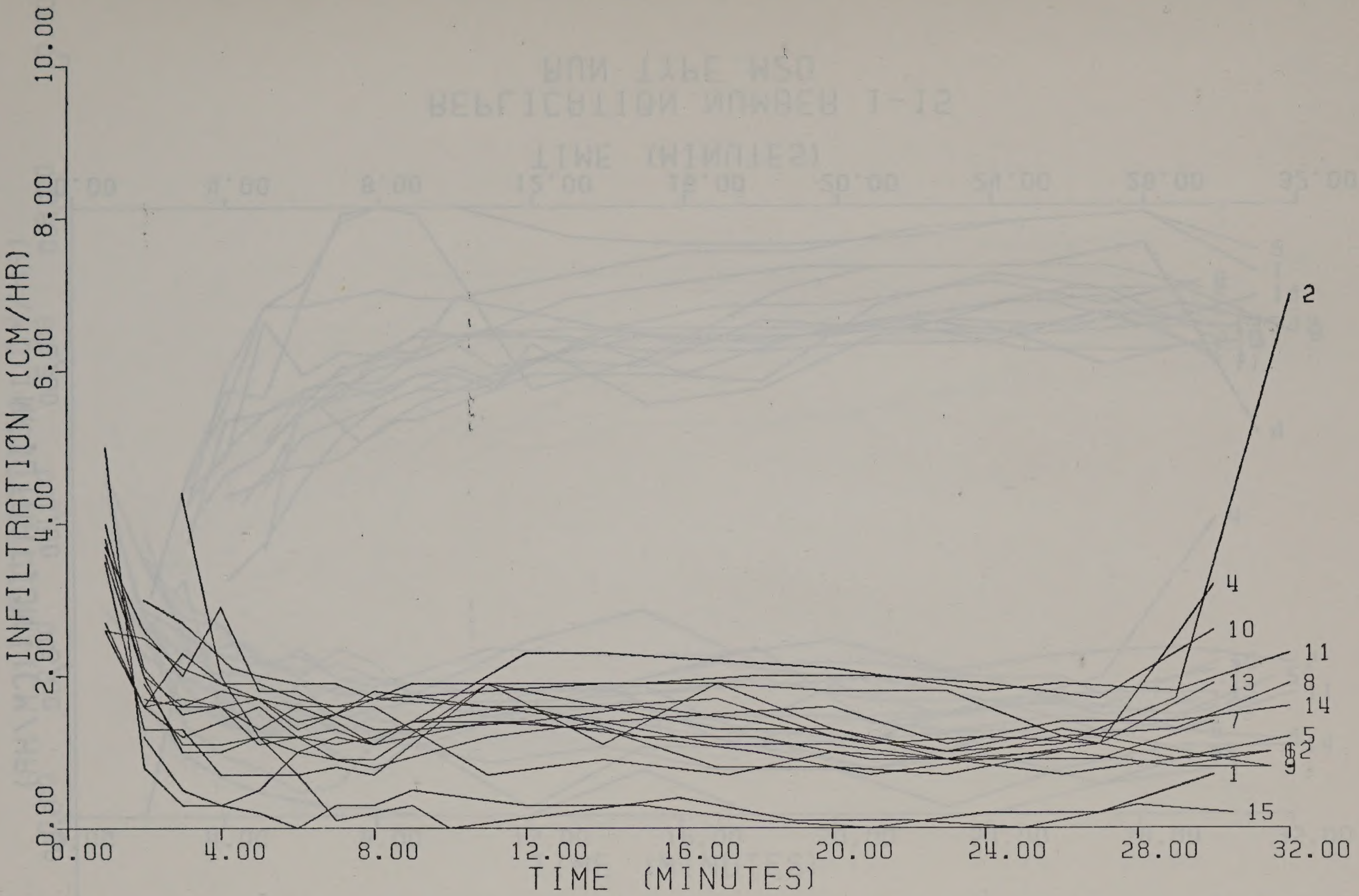
REPLICATION NUMBER 1-15
RUN TYPE N1D



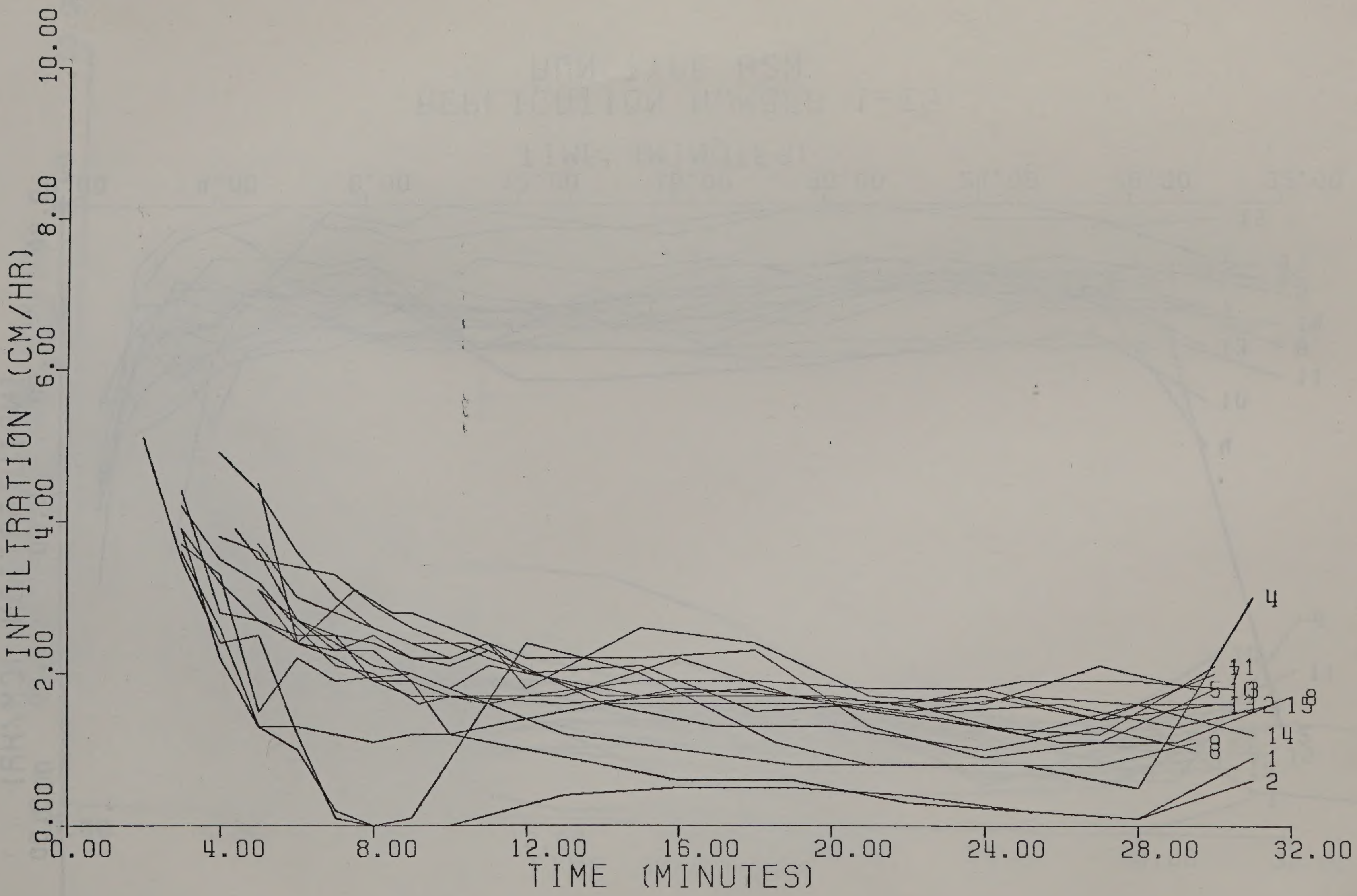
REPLICATION NUMBER 1-15
RUN TYPE N1W



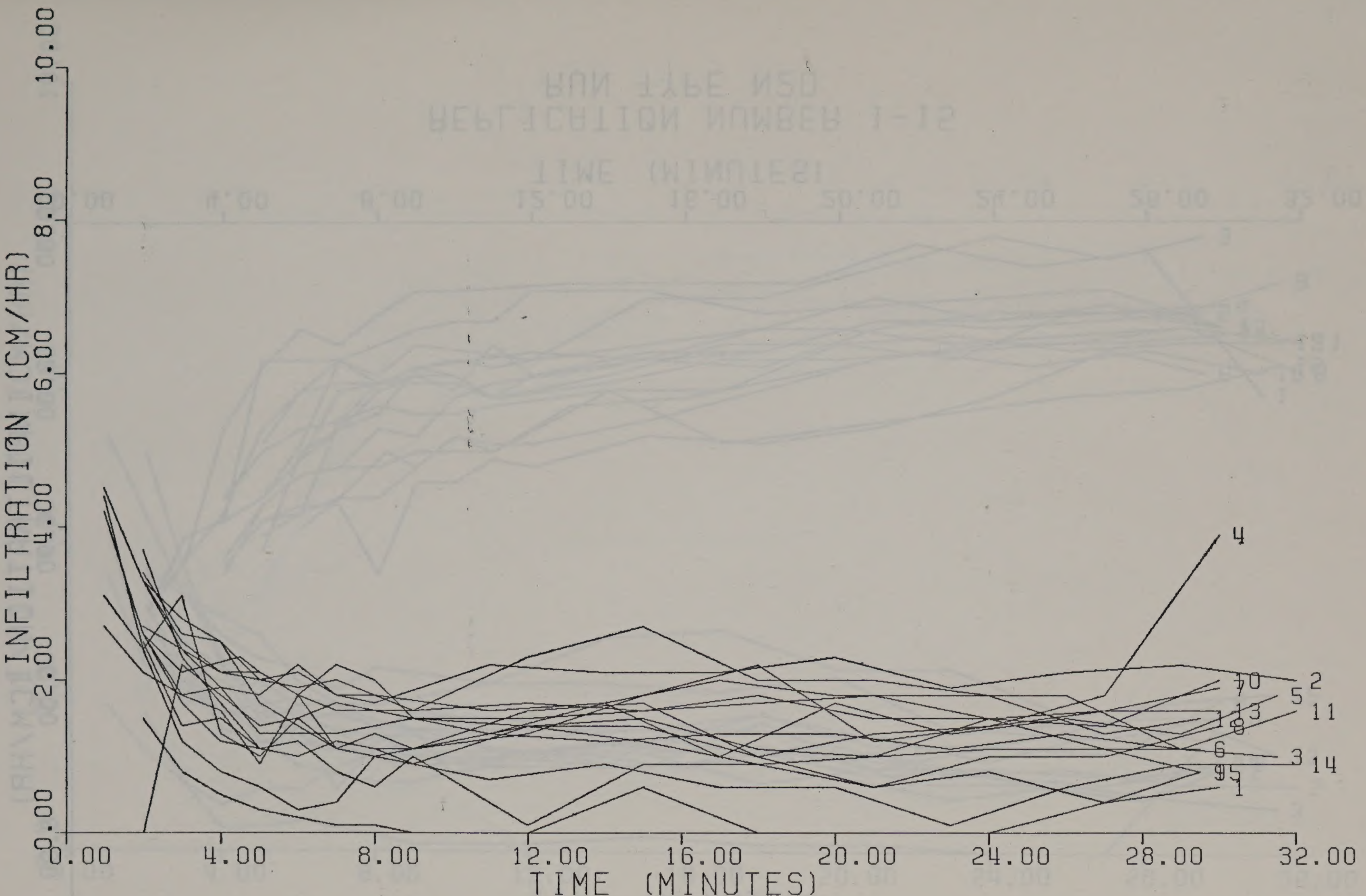
REPLICATION NUMBER 1-15
RUN TYPE B2D



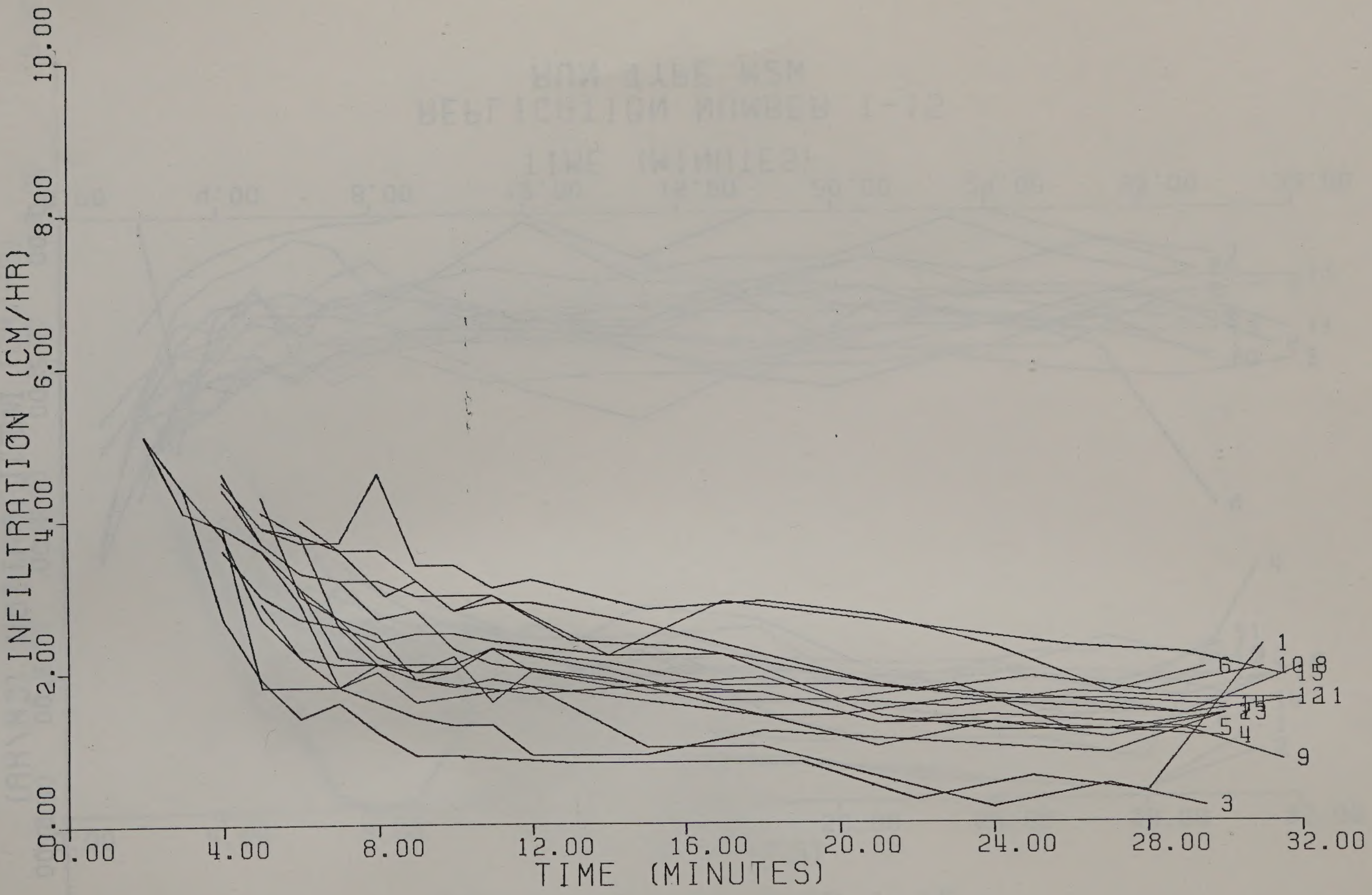
REPLICATION NUMBER 1-15
RUN TYPE B2W



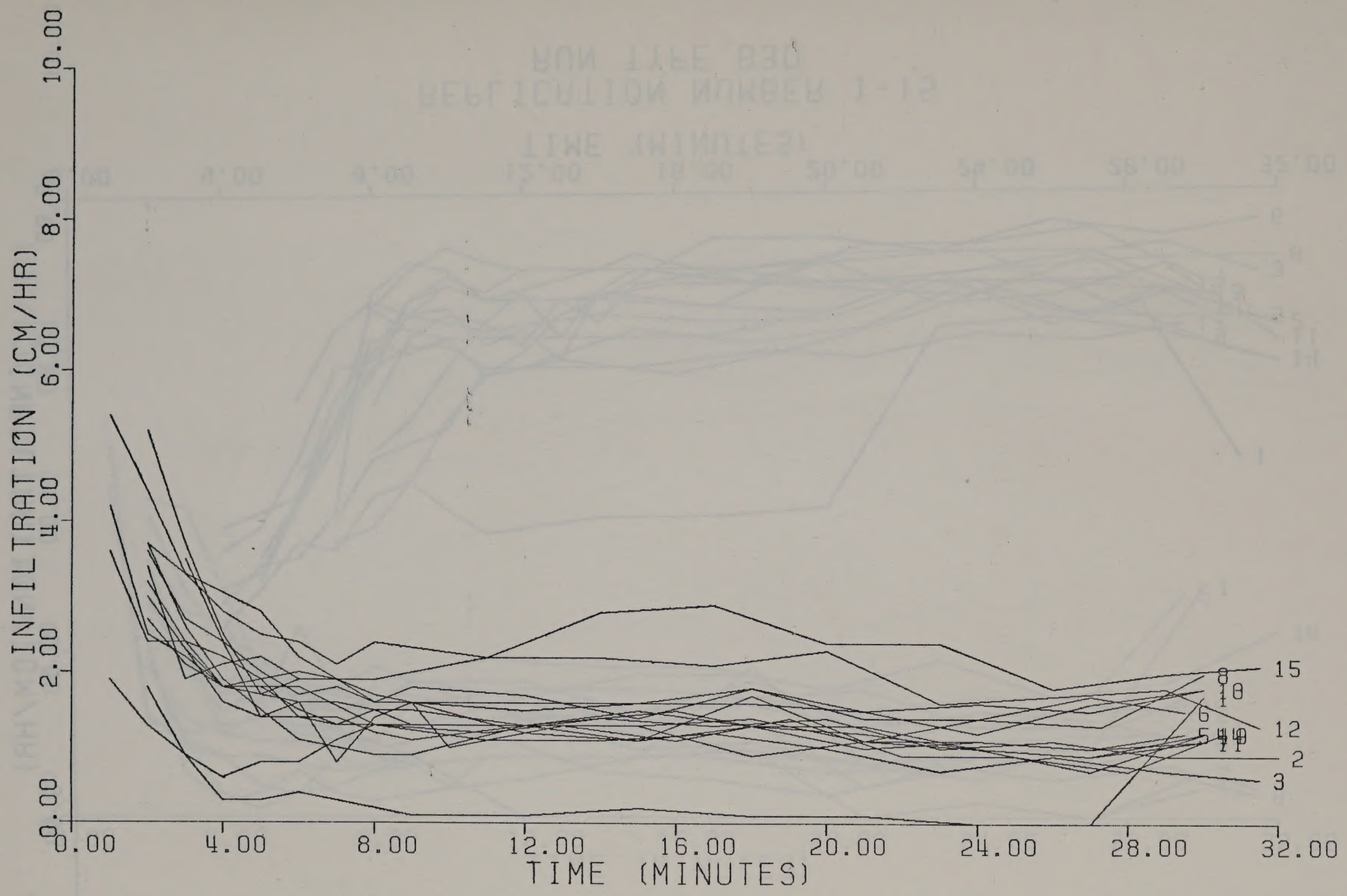
REPLICATION NUMBER 1-15
RUN TYPE M2D



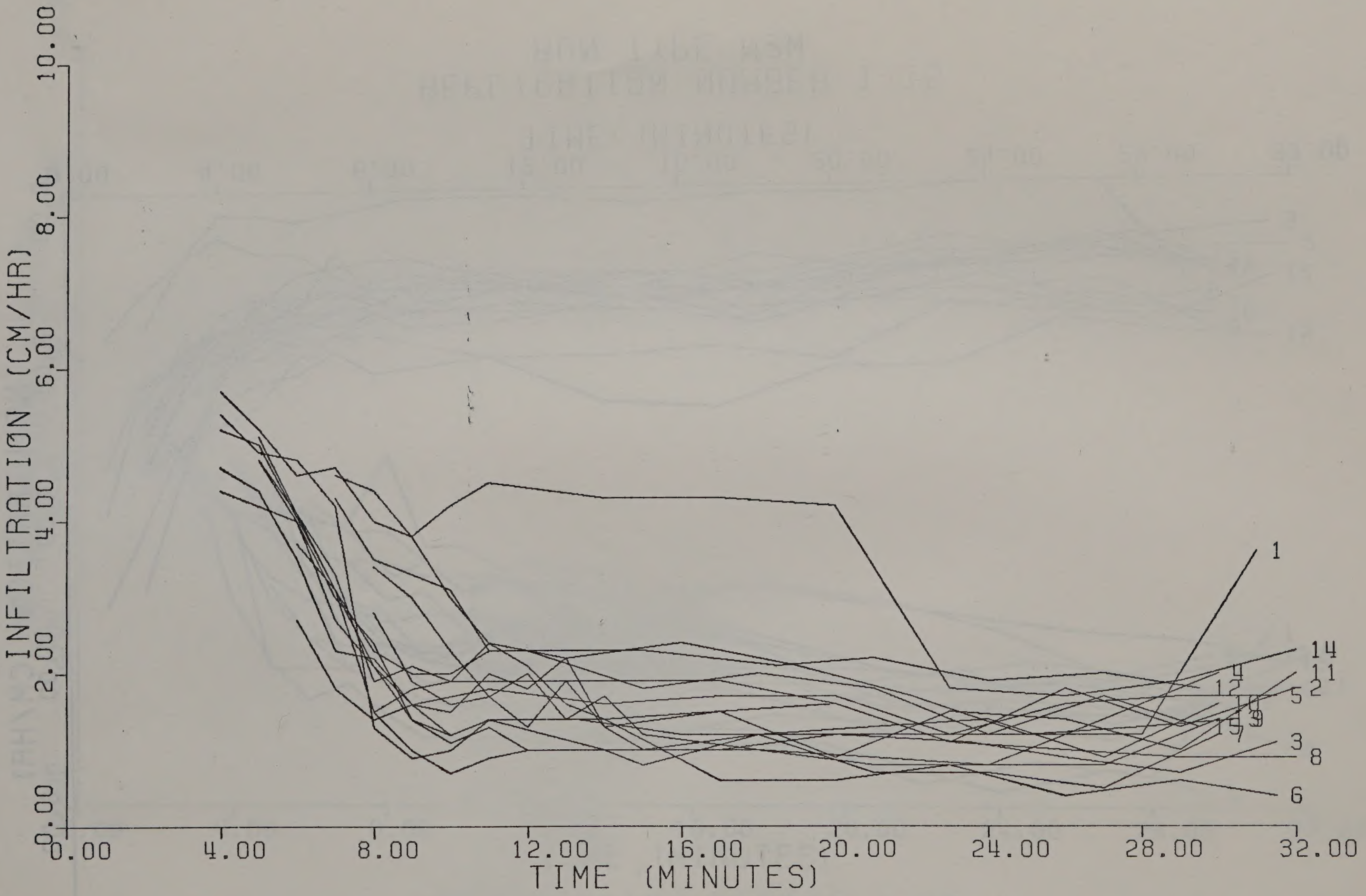
REPLICATION NUMBER 1-15
RUN TYPE M2W



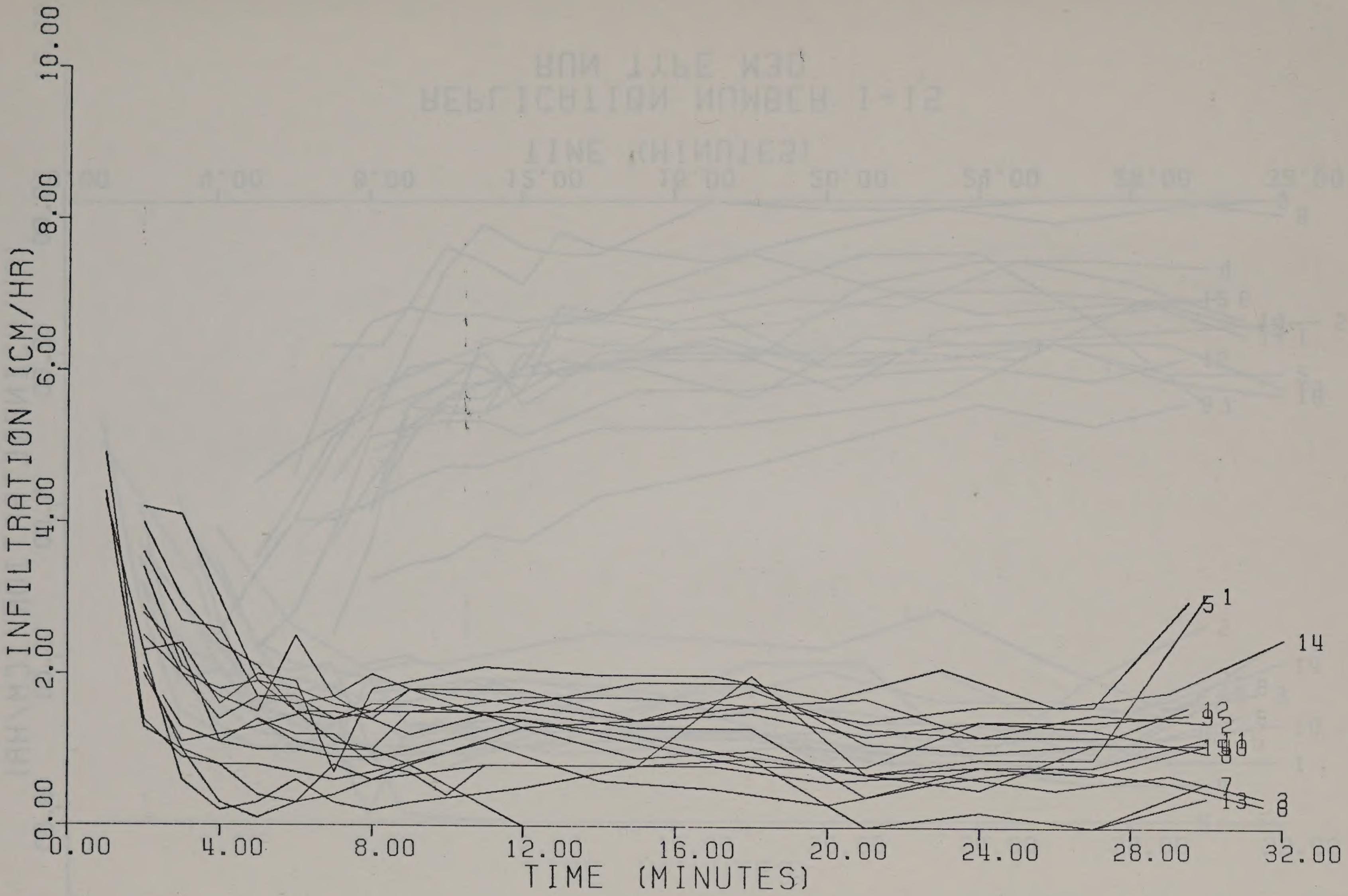
REPLICATION NUMBER 1-15
RUN TYPE N2D



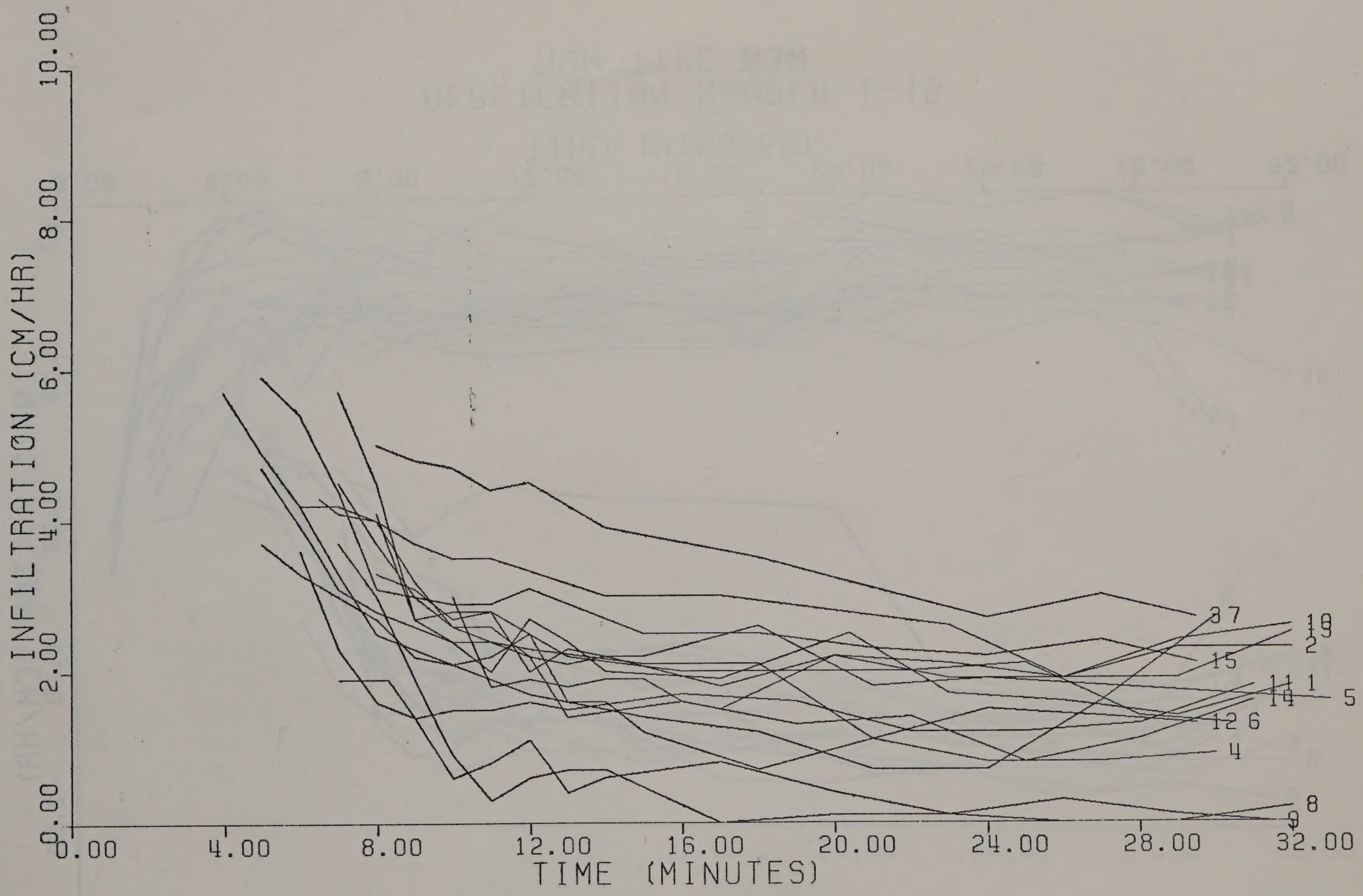
REPLICATION NUMBER 1-15
RUN TYPE N2W



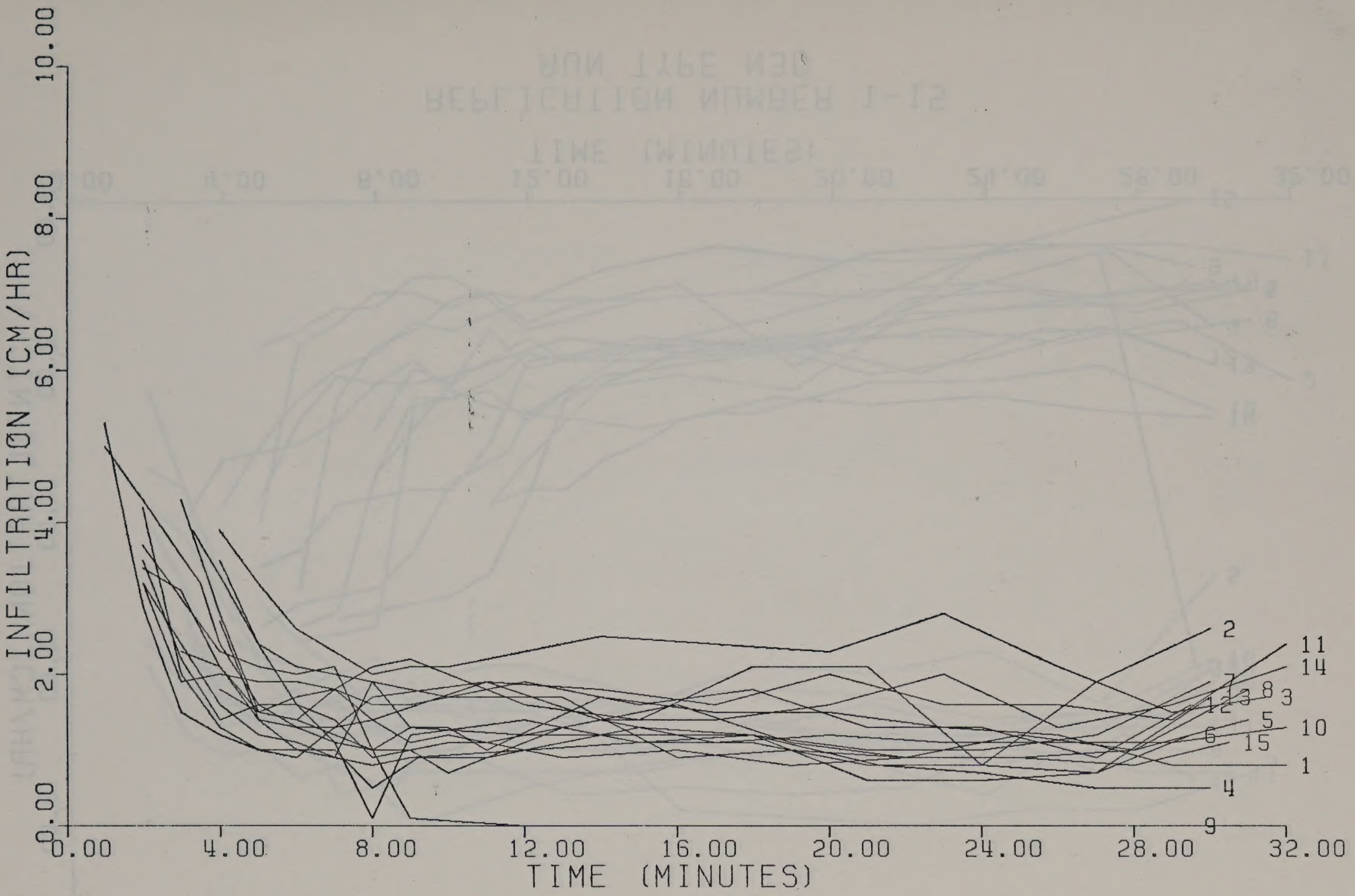
REPLICATION NUMBER 1-15
RUN TYPE B3D



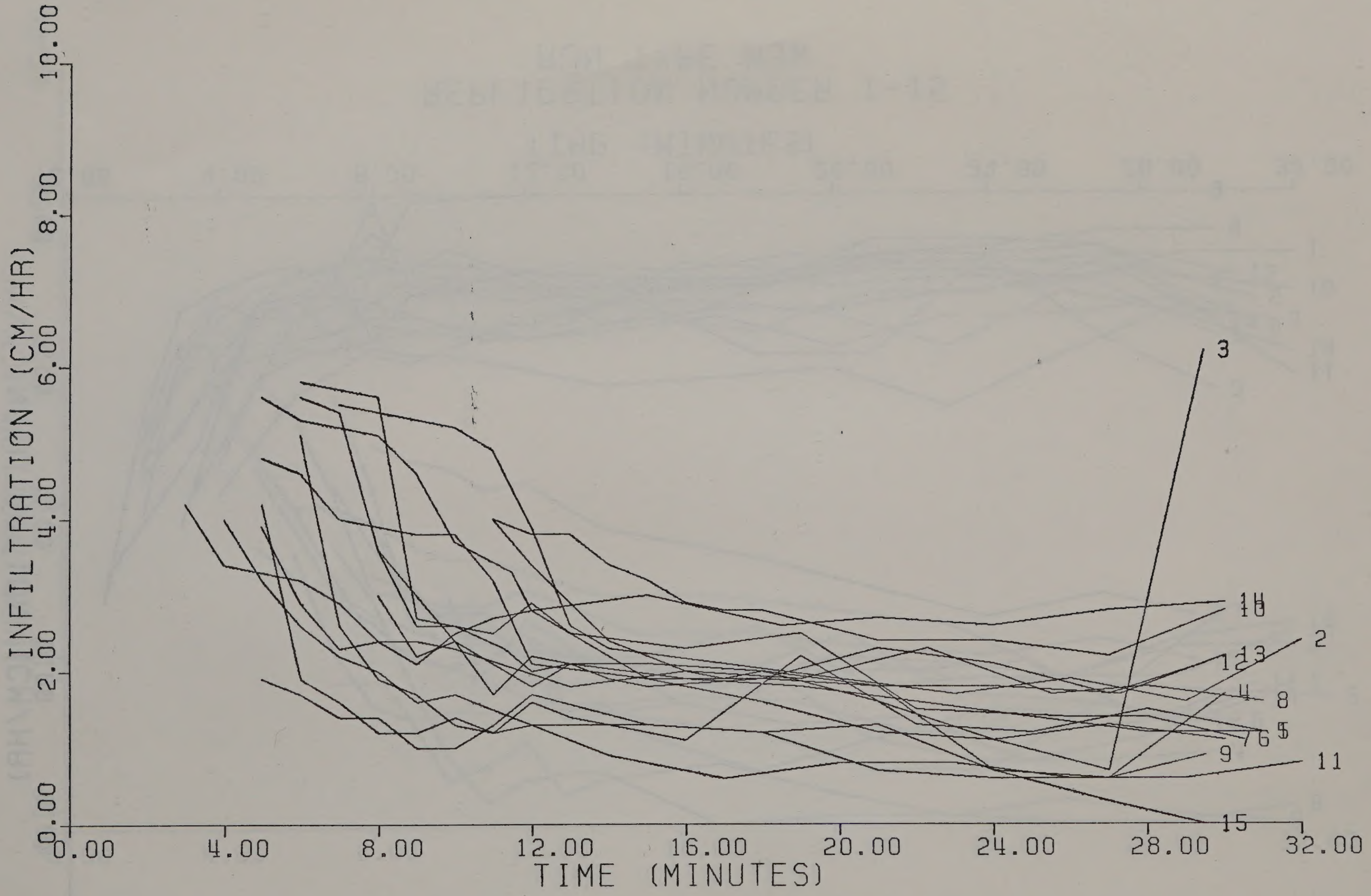
REPLICATION NUMBER 1-15
RUN TYPE B3W



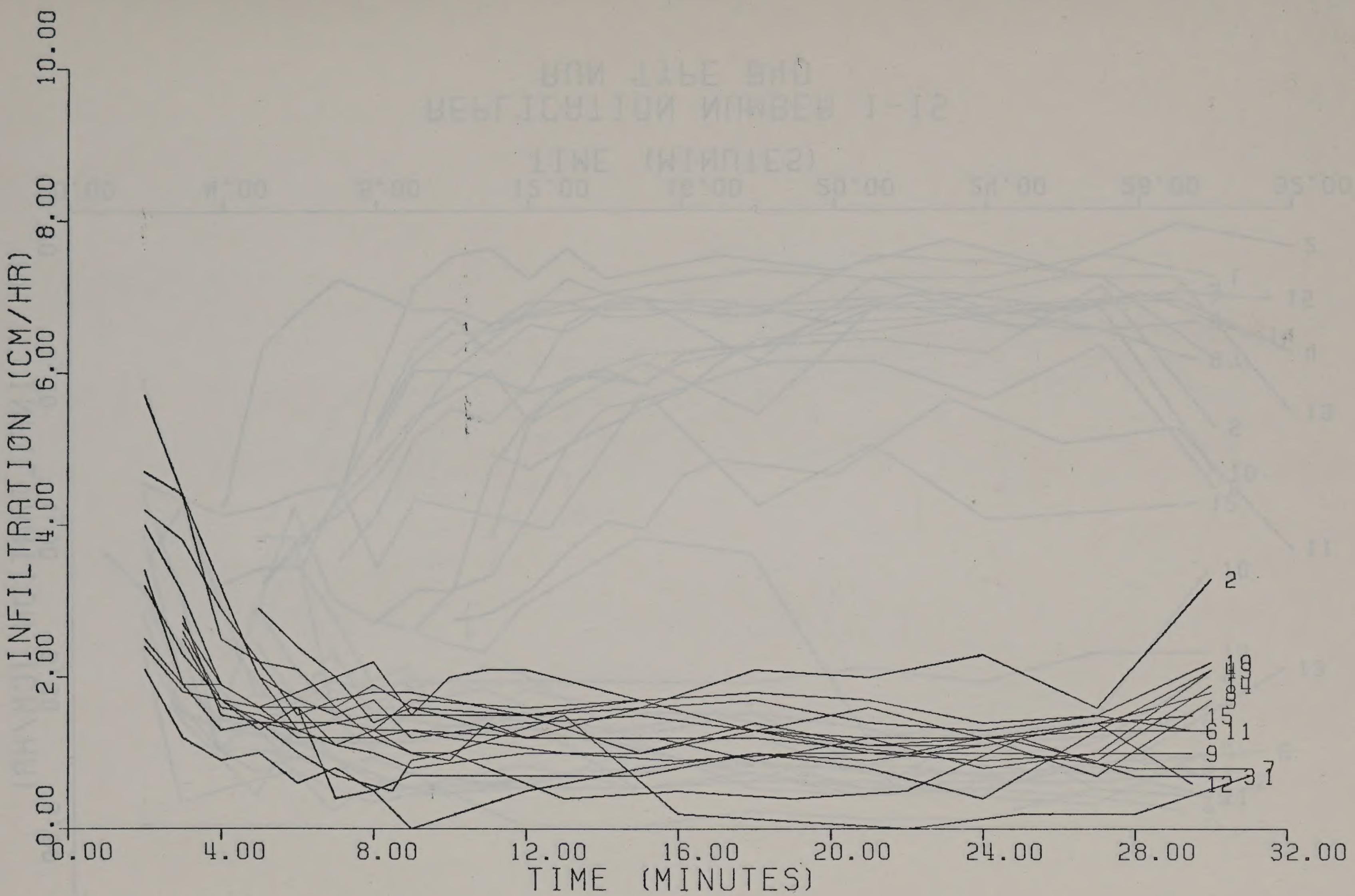
REPLICATION NUMBER 1-15
RUN TYPE M3D



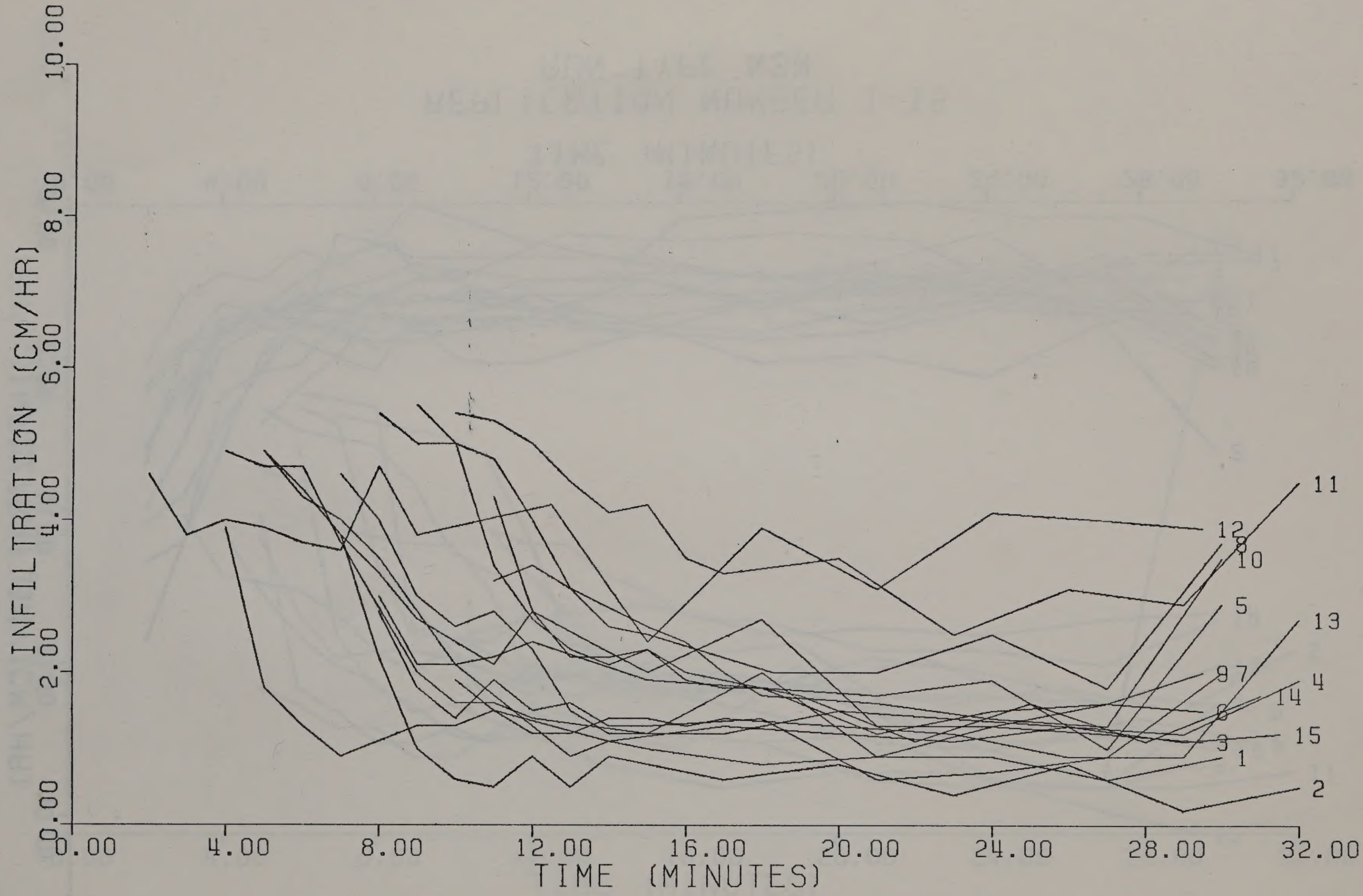
REPLICATION NUMBER 1-15
RUN TYPE M3W



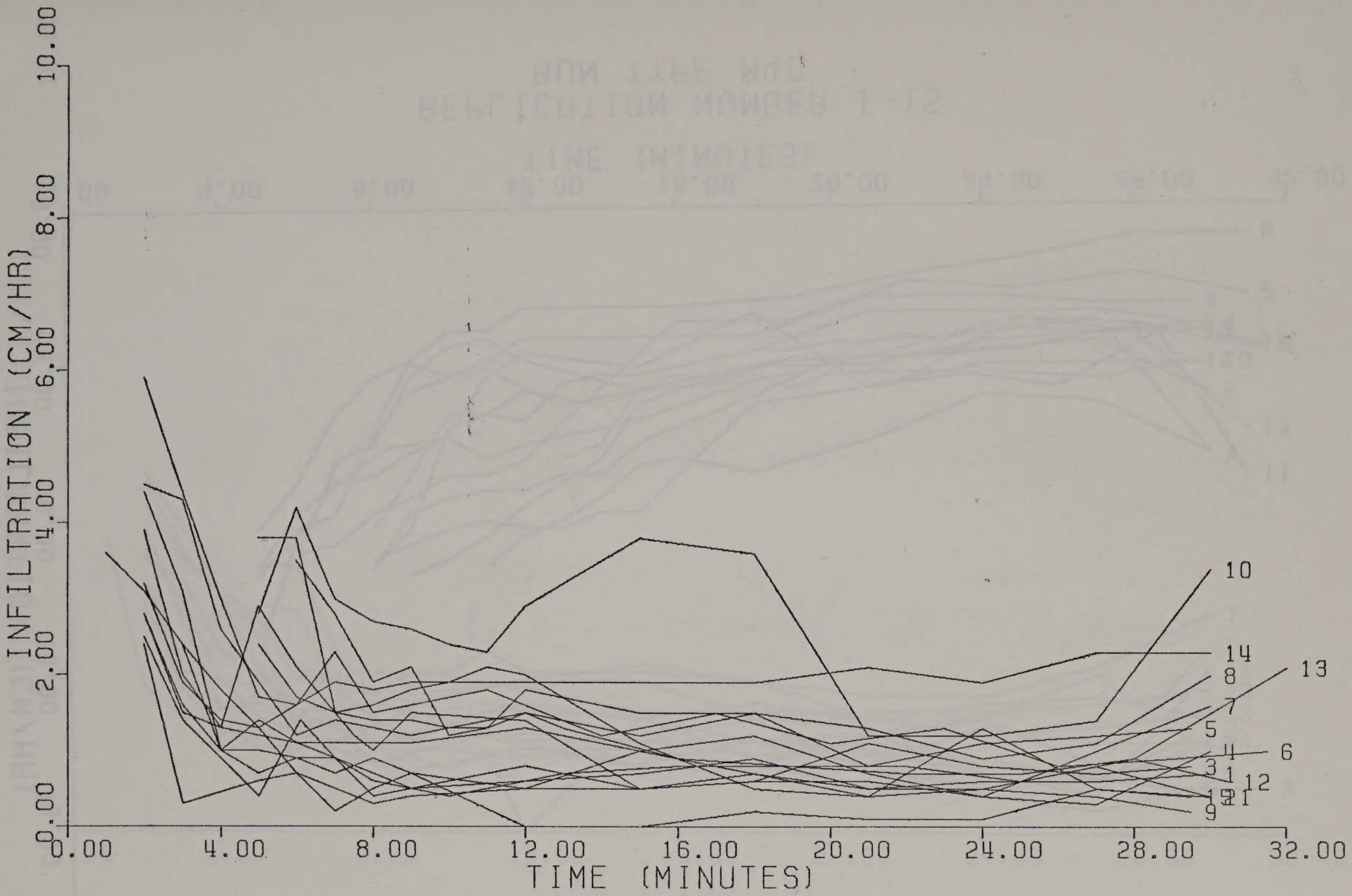
REPLICATION NUMBER 1-15
RUN TYPE N3D



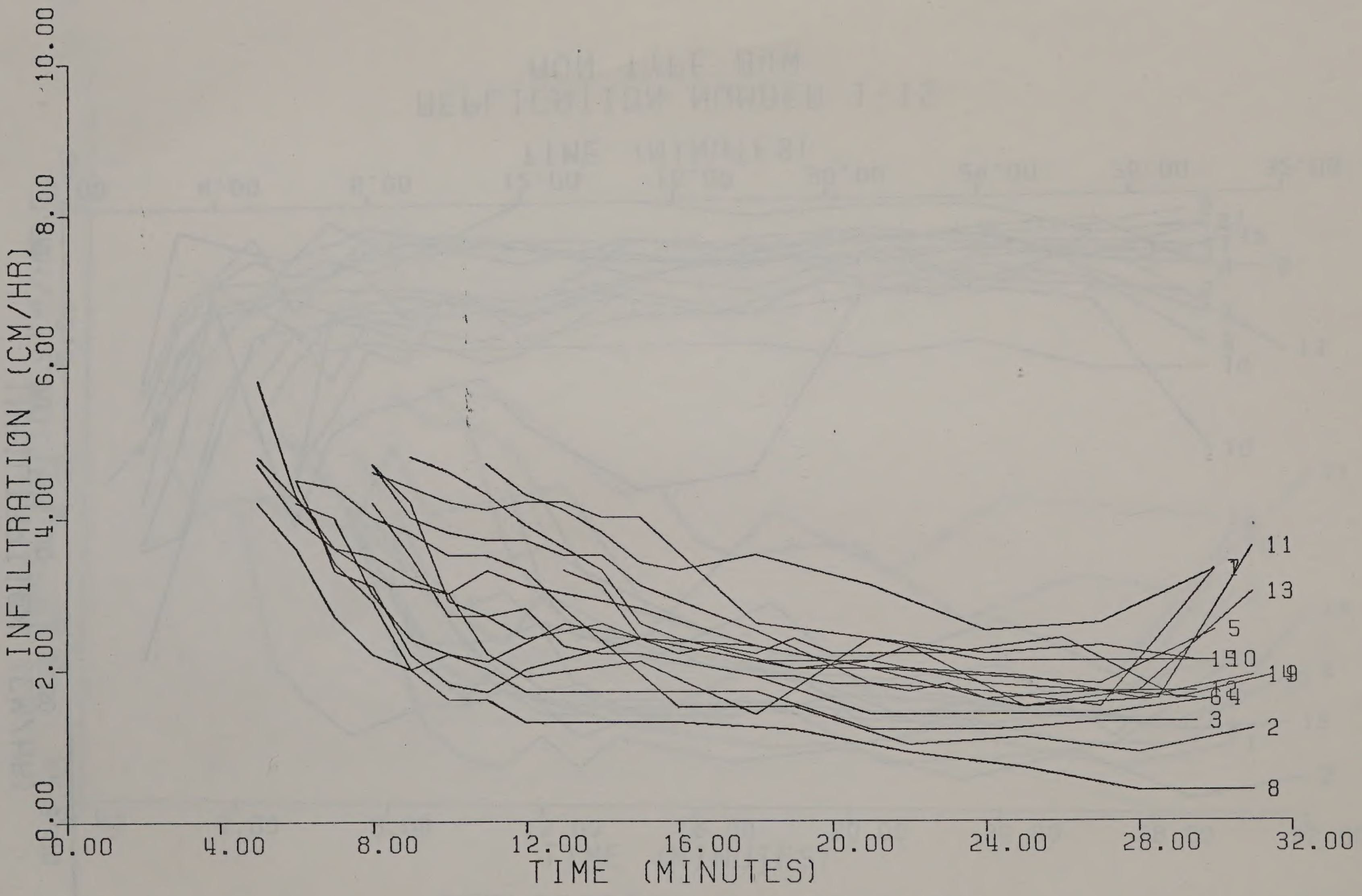
REPLICATION NUMBER 1-15
RUN TYPE N3W



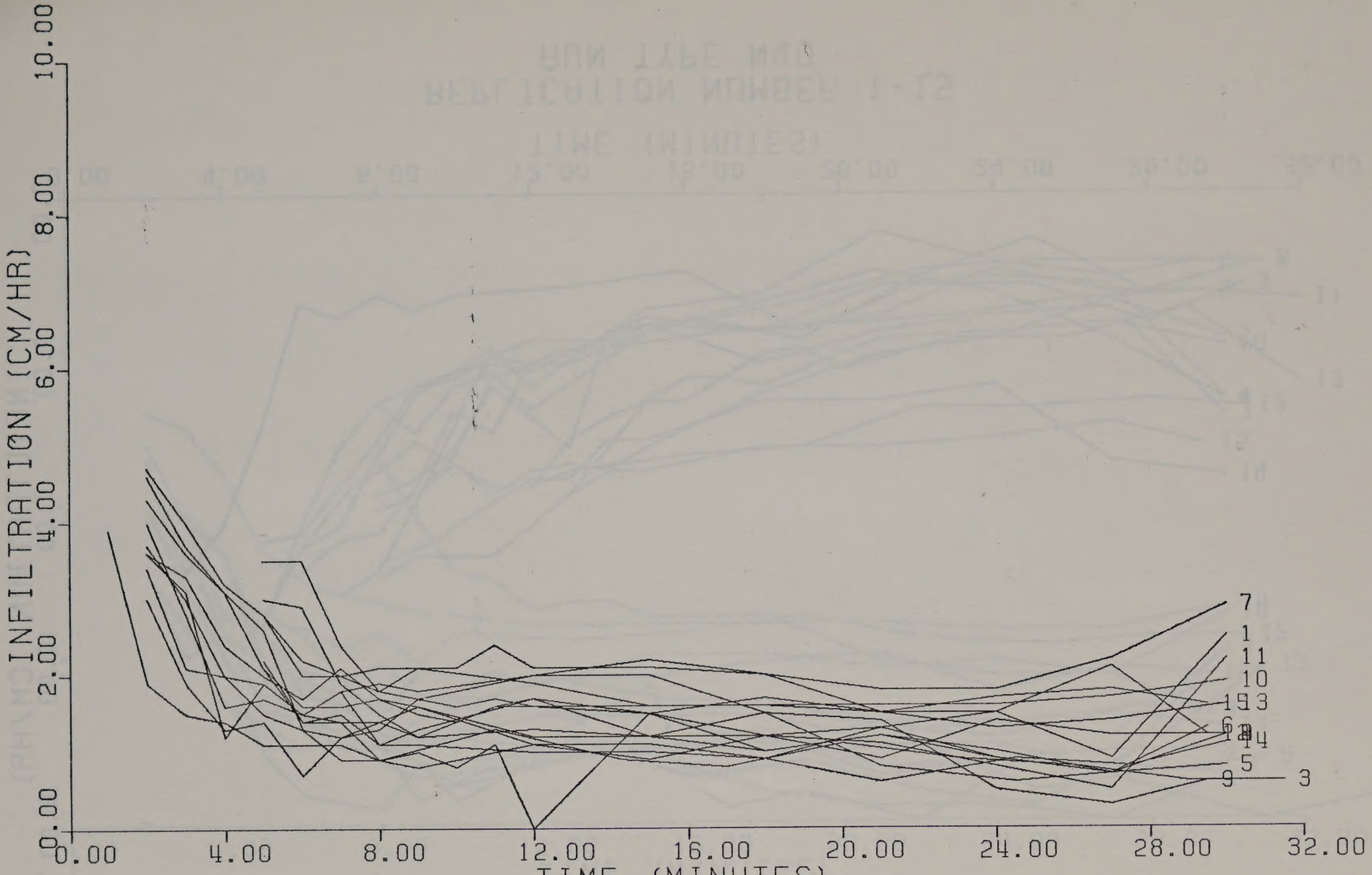
REPLICATION NUMBER 1-15
RUN TYPE B4D



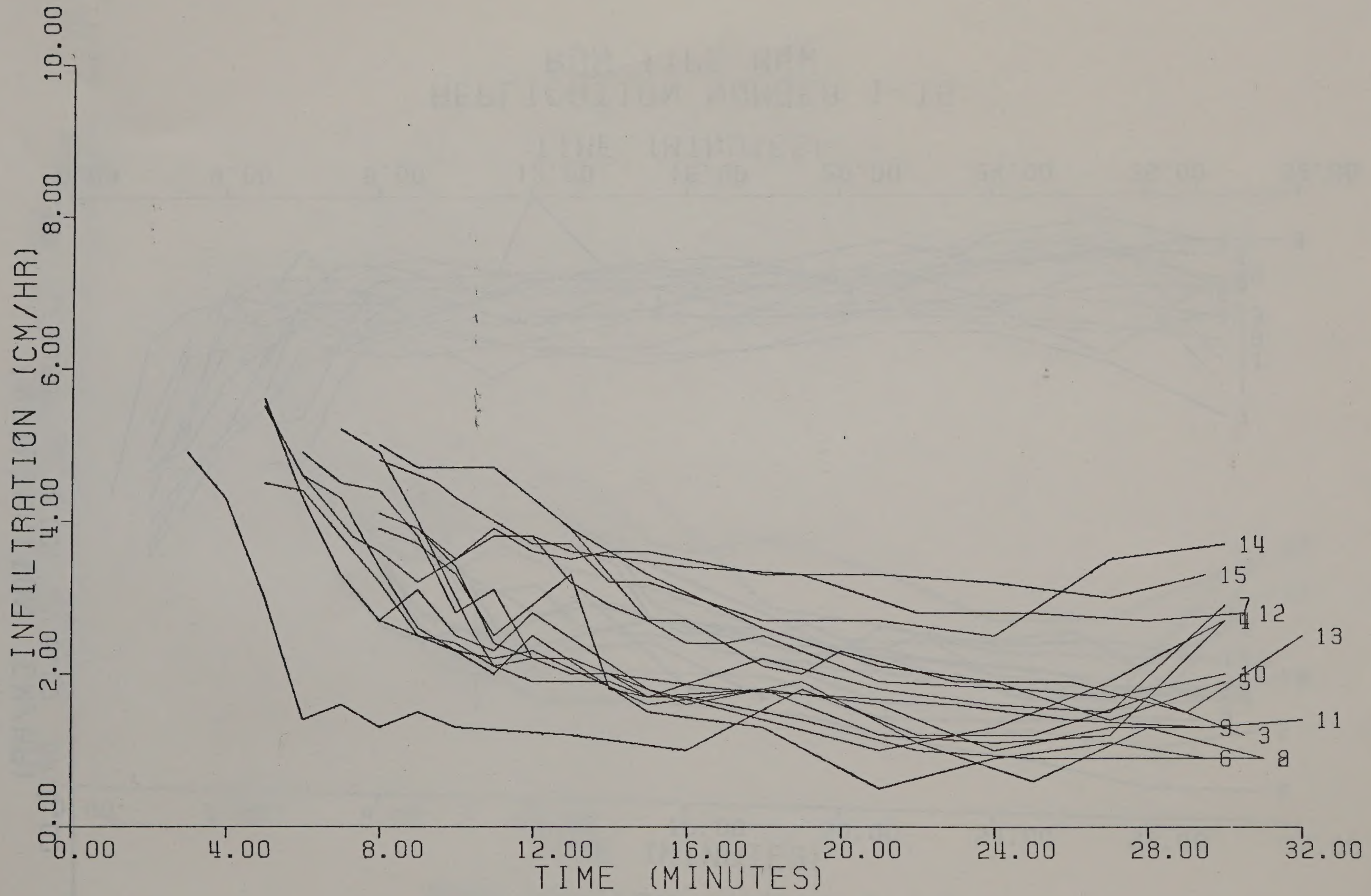
REPLICATION NUMBER 1-15
RUN TYPE B4W



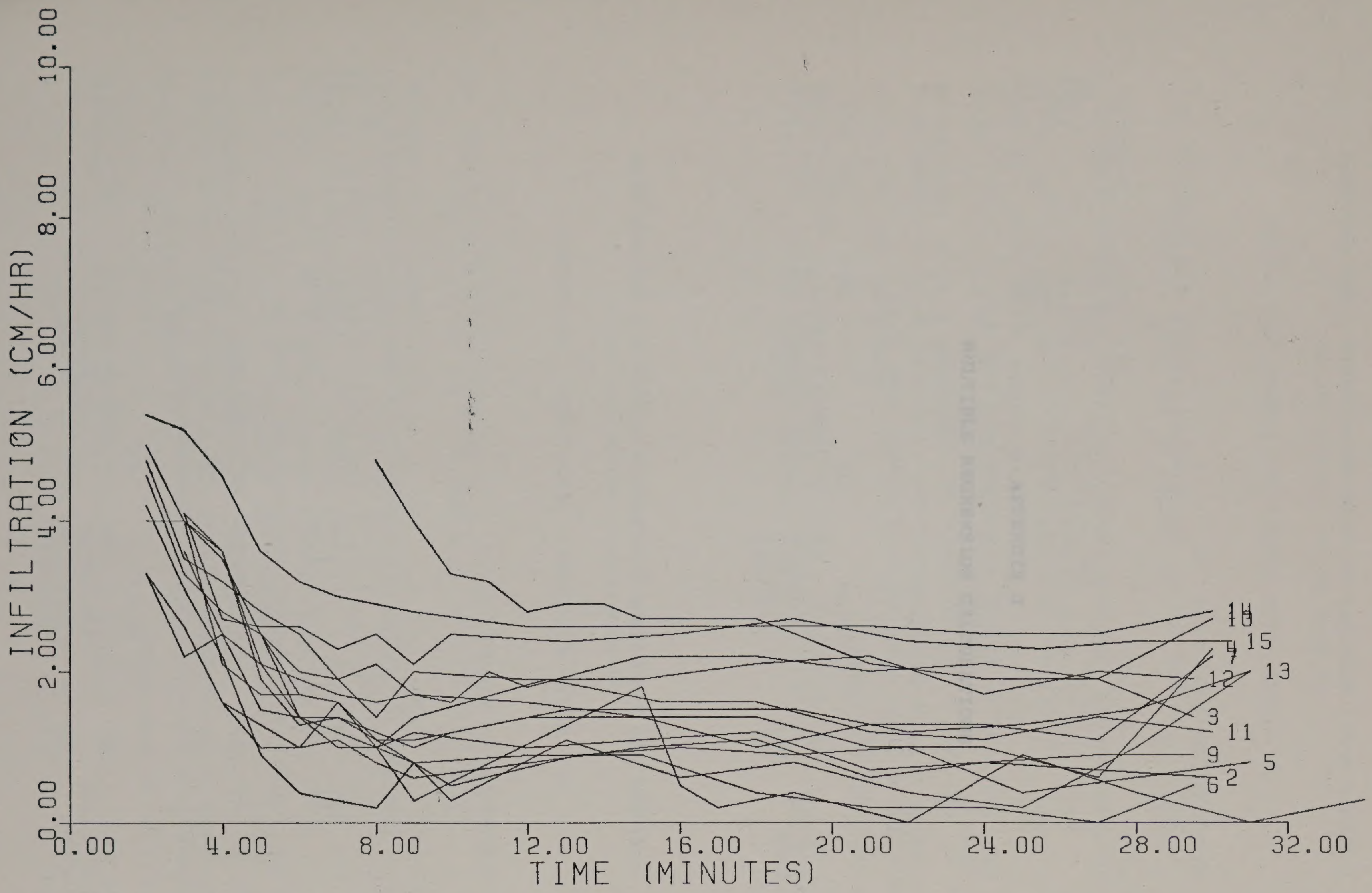
REPLICATION NUMBER 1-15
RUN TYPE M4D



REPLICATION NUMBER 1-15
RUN TYPE M4W



REPLICATION NUMBER 1-15
RUN TYPE N4D



REPLICATION NUMBER 1-15
RUN TYPE N4W

APPENDIX J

MULTIPLE REGRESSION CALCULATIONS

Table J.1. Multiple Regression Equation 1 for Dry Runs on Bare Plots.

$Y = EC2,\quad X1 = DISC^2,\quad X2 = DISC,\quad X3 = SLOP$

```
THE REGRESSION EQUATION IS
Y =     103. -   .227 X1 +  16.4 X2
    + 4389. X3

                                               ST. DEV.      T-RATIO =
         COLUMN       COEFFICIENT              OF COEF.      COEF/S.D.
          --                102.6                120.9            0.85
X1       C21             -0.22666              0.07468           -3.04
X2       C6                16.433                4.984            3.30
X3       C13                 4389                 2823            1.55

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 250.7
WITH (  60- 4) =  56 DEGREES OF FREEDOM

R-SQUARED = 18.1 PERCENT
R-SQUARED = 13.7 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO         DF              SS        MS=SS/DF
REGRESSION       3          775690          258563
RESIDUAL        56         3519979           62857
TOTAL           59         4295669
```

Table J.2. Multiple Regression Equation 2 for Wet Runs on Bare Plots

$Y = EC2,\quad X1 = SLOP,\quad X2 = DISC,\quad X3 = DISC^2$

```
THE REGRESSION EQUATION IS
Y =     20.6 + 6156. X1 +  13.2 X2
    -   .170 X3

                                               ST. DEV.      T-RATIO =
         COLUMN       COEFFICIENT              OF COEF.      COEF/S.D.
          --                 20.6                112.5            0.18
X1       C13                 6156                 2627            2.34
X2       C6                13.155                4.638            2.84
X3       C21             -0.17000              0.06948           -2.45

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 233.3
WITH (  60- 4) =  56 DEGREES OF FREEDOM

R-SQUARED = 18.5 PERCENT
R-SQUARED = 14.2 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO         DF              SS        MS=SS/DF
REGRESSION       3          692528          230843
RESIDUAL        56         3047503           54420
TOTAL           59         3740032
```

Table J.3. Multiple Regression Equation 3 for Dry Runs on Bare Plots.

Y = INF, X1 = RFR, X2 = DISC^2

```
THE REGRESSION EQUATION IS
Y = -   .922 +   .254 X1 + .0001 X2

                                            ST. DEV.      T-RATIO =
         COLUMN       COEFFICIENT          OF COEF.      COEF/S.D.
          --             -0.9221            0.3719          -2.48
X1       C11             0.25375            0.05789          4.38
X2       C21          0.00009687         0.00001520          6.37

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 0.1984
WITH (   60- 3) =   57 DEGREES OF FREEDOM

R-SQUARED = 54.5 PERCENT
R-SQUARED = 52.9 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF            SS         MS=SS/DF
REGRESSION      2       2.68843          1.34421
RESIDUAL       57       2.24353          0.03936
TOTAL          59       4.93196
```

Table J.4. Multiple Regression Equation 4 for Wet Runs on Bare Plots

Y = INF, X1 = DISC^2, X2 = RFR

```
THE REGRESSION EQUATION IS
Y = -  1.34 + .0000 X1 +   .283 X2

                                          ST. DEV.      T-RATIO =
         COLUMN     COEFFICIENT           OF COEF.      COEF/S.D.
          --            -1.3389             0.3656          -3.66
X1       C21         0.00003703         0.00001510           2.45
X2       C12            0.28293            0.05585           5.07

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 0.1974
WITH (   60- 3) =   57 DEGREES OF FREEDOM

R-SQUARED = 33.8 PERCENT
R-SQUARED = 31.4 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF            SS         MS=SS/DF
REGRESSION      2       1.13136          0.56568
RESIDUAL       57       2.22014          0.03895
TOTAL          59       3.35150
```

Table J.5. Multiple Regression Equation 5 for Wet Runs on Plots with Mat Saltbush.

Y = EC2, X1 = SLOP, X2 = DISC, X3 = DISC^2

```
THE REGRESSION EQUATION IS
Y =      236. + 4031. X1 -   6.75 X2
    +   .181 X3

                                              ST. DEV.     T-RATIO =
        COLUMN      COEFFICIENT               OF COEF.     COEF/S.D.
        --                235.59                83.02          2.84
X1      C7                  4031                 1942          2.08
X2      C2                -6.755                3.752         -1.80
X3      C8               0.18138              0.05464          3.32

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 211.2
WITH (  60- 4) =  56 DEGREES OF FREEDOM

R-SQUARED = 39.3 PERCENT
R-SQUARED = 36.0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF          SS        MS=SS/DF
REGRESSION      3     1615172          538391
RESIDUAL       56     2498382           44614
TOTAL          59     4113554
```

Table J.6. Multiple Regression Equation 6 for Dry Runs on Plots with Mat Saltbush.

Y = EC2, X1 = DISC^2, X2 = SLOP, X3 = DISC

```
THE REGRESSION EQUATION IS
Y =      185. +   .174 X1 + 4362. X2
    -   7.35 X3

                                              ST. DEV.     T-RATIO =
        COLUMN      COEFFICIENT               OF COEF.     COEF/S.D.
        --                184.54                78.37          2.35
X1      C8               0.17395              0.05158          3.37
X2      C7                  4362                 1833          2.38
X3      C2                -7.351                3.541         -2.08

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 199.4
WITH (  60- 4) =  56 DEGREES OF FREEDOM

R-SQUARED = 36.1 PERCENT
R-SQUARED = 32.7 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF          SS        MS=SS/DF
REGRESSION      3     1260413          420138
RESIDUAL       56     2226329           39756
TOTAL          59     3486742
```

Table J.7. Multiple Regression Equation 7 for Dry Runs on Plots with Mat Saltbush.

Y = INF, X1 = RFR, X2 = VEGC, X3 = DISC^2

```
THE REGRESSION EQUATION IS
Y = -   1.26 +   .285 X1 + .0190 X2
    + .0001 X3

                                                 ST. DEV.      T-RATIO =
        COLUMN        COFFFICIENT                OF COEF.      COFF/S.D.
        --                 -1.2606                0.2609          -4.83
X1      C3                  0.28529               0.03873          7.37
X2      C1                 0.019043              0.003761          5.06
X3      C7               0.00011285            0.00001240          9.10
THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 0.1550
WITH (  60- 4) =  56 DFGRFES OF FREEDOM

R-SQUARED = 72.8 PERCENT
R-SQUARED = 71.4 PFRCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF           SS        MS=SS/DF
REGRESSION      3      3.60499         1.20166
RESIDUAL       56      1.34491         0.02402
TOTAL          59      4.94990
```

Table J.8. Multiple Regression Equation 8 for Wet Runs on Plots with Mat Saltbush.

Y = INF, X1 = VEGC, X2 = RFR, X3 = DISC^2

```
THE REGRESSION FQUATION IS
Y = -   1.06 + .0113 X1 +   .235 X2
    + .0000 X3

                                                 ST. DEV.      T-RATIO =
        COLUMN        COEFFICIENT                OF COEF.      COEF/S.D.
        --                 -1.0617                0.3137          -3.38
X1      C1                 0.011267              0.003254          3.46
X2      C4                  0.23540               0.04631          5.08
X3      C7               0.00002947            0.00001068          2.76
THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 0.1334
WITH (  60- 4) =  56 DEGREES OF FREEDOM

R-SQUARED = 40.1 PFRCENT
R-SQUARED = 36.9 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF           SS        MS=SS/DF
REGRESSION      3      0.66804         0.22268
RESIDUAL       56      0.99672         0.01780
TOTAL          59      1.66476
```

Table J.9. Multiple Regression Equation 9 for Dry Runs on Plots with Nuttal Bush.

Y = EC2, X1 = DISC^2, X2 = SLOP

```
THE REGRESSION EQUATION IS
Y =     178. + .0581 X1 + 3641. X2

                                                  ST. DEV.      T-RATIO =
        COLUMN       COEFFICIENT                  OF COEF.      COEF/S.D.
         --               178.44                   64.40           2.77
X1      C21             0.05812                  0.01825           3.19
X2      C13                3641                     1436           2.54

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 201.2
WITH (  60- 3) =  57 DEGREES OF FREEDOM

R-SQUARED = 21.4 PERCENT
R-SQUARED = 18.7 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF            SS          MS=SS/DF
REGRESSION     2        629374            314687
RESIDUAL      57       2306797             40470
TOTAL         59       2936171
```

Table J.10. Multiple Regression Equation 10 for Wet Runs on Plots with Nuttal Bush.

Y = EC2, X1 = SLOP, X2 = DISC^2

```
THE REGRESSION EQUATION IS
Y =     71.5 + 4561. X1 + .0502 X2

                                                  ST. DEV.      T-RATIO =
        COLUMN       COEFFICIENT                  OF COEF.      COEF/S.D.
         --                71.50                   51.13           1.40
X1      C13                 4561                    1140           4.00
X2      C21              0.05020                 0.01449           3.47

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 159.7
WITH (  60- 3) =  57 DEGREES OF FREEDOM

R-SQUARED = 31.5 PERCENT
R-SQUARED = 29.1 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF            SS          MS=SS/DF
REGRESSION     2        669824            334912
RESIDUAL      57       1454110             25511
TOTAL         59       2123934
```

Table J.11. Multiple Regression Equation 11 for Dry Runs on Plots with Nuttal Bush.

Y = INF, X1 = VEGC, X2 = RFR, X3 = DISC^2

```
THE REGRESSION EQUATION IS
Y = -   1.12 + .0081 X1 +   .289 X2
    + .0001 X3

                                                   ST. DEV.      T-RATIO =
        COLUMN       COEFFICIENT                   OF COEF.      COEF/S.D.
        --                -1.1231                   0.3788          -2.96
X1      C1               0.008127                 0.003482           2.33
X2      C11               0.28885                  0.05662           5.10
X3      C21            0.00010572               0.00001854           5.70

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 0.1920
WITH (   60-  4) =   56 DEGREES OF FREEDOM

R-SQUARED = 54.4 PERCENT
R-SQUARED = 52.0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO         DF              SS          MS=SS/DF
REGRESSION       3         2.46243           0.82081
RESIDUAL        56         2.06387           0.03685
TOTAL           59         4.52629
```

Table J.12. Multiple Regression Equation 12 for Wet Runs on Plots with Nuttal Bush.

Y = INF, X1 = RFR, X2 = DISC^2

```
THE REGRESSION EQUATION IS
Y = -   1.42 + .316 X1 + .0000 X2

                                                  ST. DEV.       T-RATIO =
        COLUMN       COEFFICIENT                  OF COEF.       COEF/S.D.
        --                -1.4163                  0.2494           -5.68
X1      C12               0.31583                  0.03834           8.24
X2      C21            0.00002215               0.00001245           1.78

THE ST. DEV. OF Y ABOUT REGRESSION LINE IS
S = 0.1374
WITH (   60-  3) =   57 DEGREES OF FREEDOM

R-SQUARED = 56.1 PERCENT
R-SQUARED = 54.6 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO         DF              SS          MS=SS/DF
REGRESSION       2         1.37528           0.68764
RESIDUAL        57         1.07601           0.01888
TOTAL           59         2.45129
```

APPENDIX K

TABLES FOR ANALYSIS OF VARIANCE (ANOVA)

Table K.1. ANOVA for Vegetative Cover, Point Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	214.533	6	35.756	1.498
Tramp	338.200	3	112.733	4.724
Veg	8330.978	2	4165.489	174.561
Error	4008.934	168	23.863	1.000

Table K.2. ANOVA for Litter Cover, Point Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	209.733	6	34.956	1.094
Tramp	436.133	3	145.378	4.552
Veg	1635.733	2	817.867	25.608
Error	5365.599	168	31.938	1.000

Table K.3. ANOVA for Rock Cover, Point Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	43.967	6	7.328	1.360
Tramp	101.467	3	33.822	6.277
Veg	54.344	2	27.172	5.043
Error	905.200	168	5.388	1.000

Table K.4. ANOVA for Total Cover, Point Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	187.700	6	31.283	0.407
Tramp	2274.067	3	758.022	9.852
Veg	15484.078	2	7742.039	100.626
Error	12925.734	168	76.939	1.000

Table K.5. ANOVA for Total Bare, Point Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	188.544	6	31.424	0.409
Tramp	2283.972	3	761.324	9.898
Veg	15474.033	2	7737.017	100.587
Error	12922.399	168	76.919	1.000

Table K.6. ANOVA for Disturbed Area, Point Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	290.344	6	48.391	1.633
Tramp	92034.156	3	30678.052	1035.162
Veg	292.811	2	146.406	4.940
Error	4978.800	168	29.636	1.000

Table K.7. ANOVA for Vegetative Cover, Cell Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	215.824	6	35.971	1.277
Tramp	322.981	3	107.660	3.822
Veg	10018.684	2	5009.342	177.813
Error	4732.978	168	28.172	1.000

Table K.8. ANOVA for Litter Cover, Cell Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	213.419	6	38.570	1.383
Tramp	240.665	3	80.222	2.877
Veg	1562.647	2	781.324	28.016
Error	4685.237	168	27.888	1.000

Table K.9. ANOVA for Rock Cover, Cell Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	27.405	6	4.568	0.949
Tramp	54.101	3	18.034	3.745
Veg	51.543	2	25.772	5.352
Error	809.031	168	4.816	1.000

Table K.10. ANOVA for Total Cover, Cell Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	261.003	6	43.500	0.572
Tramp	1507.361	3	502.454	6.604
Veg	17543.080	2	8771.540	115.295
Error	12781.268	168	76.079	1.000

Table K.11. ANOVA for Total Bare, Cell Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	257.640	6	42.940	0.595
Tramp	1529.232	3	509.744	7.069
Veg	17435.527	2	8717.763	120.898
Error	12114.173	168	72.108	1.000

Table K.12. ANOVA for Disturbed Area, Cell Method.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	414.719	6	69.120	2.337
Tramp	102677.864	3	34225.995	1157.171
Veg	4968.980	2	142.702	4.825
Error		168	29.577	1.000

Table K.13. ANOVA for Plant Diameter.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	78.314	6	13.052	1.436
Tramp	83.570	3	27.857	3.067
Veg	9047.347	2	4523.673	497.684
Error	1527.019	168	9.089	1.000

Table K.14. ANOVA for Plant Height.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg	6.955	6	1.159	1.176
Tramp	6.961	3	2.320	2.355
Veg	1261.360	2	608.180	617.319
Error	165.513	168	0.985	1.000

Table K.15. ANOVA for Peak Flow.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	1.450	6	0.242	0.367
Tramp, veg	5.204	6	0.867	1.314
Tramp, moist	1.719	3	0.573	0.868
Tramp	5.443	3	1.814	2.748
Veg, moist	1.848	2	0.924	1.400
Veg	8.650	2	4.325	6.553
Moist	21.365	1	21.365	32.371
Error	221.763	336	0.660	1.000

Table K.16. ANOVA for Normalized Peak Flow.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	0.030	6	0.005	0.247
Tramp, veg	0.193	6	0.032	1.581
Tramp, moist	0.126	3	0.042	2.076
Tramp	0.119	3	0.040	1.977
Veg, moist	0.034	2	0.017	0.840
Veg	0.471	2	0.235	11.613
Moist	0.592	1	0.592	29.256
Error	6.799	336	0.020	1.000

Table K.17. ANOVA for Runoff Volume.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	4050446.183	6	675074.364	0.311
Tramp, veg	13271592.639	6	2211932.106	1.017
Tramp, moist	40733389.300	3	13577796.433	6.245
Tramp	230377939.311	3	76792646.437	35.322
Veg, moist	764423.372	2	382211.686	0.176
Veg	66910205.317	2	33455102.658	15.388
Moist	534794814.678	1	534794814.678	245.985
Error	730495175.599	336	2174092.817	1.000

Table K.18. ANOVA for Electrical Conductivity, Total Runoff Sample from Field Data.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	69674.172	6	11612.362	0.157
Tramp, veg	1955167.439	6	325861.240	4.397
Tramp, moist	61703.044	3	20567.681	0.278
Tramp	2740961.178	3	913653.726	12.328
Veg, moist	88574.206	2	44287.103	0.598
Veg	300015.072	2	150007.536	2.024
Moist	313762.178	1	313762.178	4.234
Error	24901797.334	336	74112.491	1.000

Table K.19. ANOVA for Electrical Conductivity, Time Weighted Sample from Field Data.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	43246.012	6	7207.669	0.140
Tramp, veg	1553696.747	6	258949.458	5.043
Tramp, moist	21215.032	3	7071.677	0.138
Tramp	1825640.735	3	608546.912	11.850
Veg, moist	41161.660	2	20580.830	0.401
Veg	180260.685	2	90130.342	1.755
Moist	309337.744	1	309337.744	6.024
Error	17254366.092	336	51352.280	1.000

Table K.20. ANOVA for Infiltration.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	0.032	6	0.005	0.109
Tramp, veg	0.442	6	0.074	1.609
Tramp, moist	1.553	3	0.518	11.261
Tramp	4.330	3	1.443	31.370
Veg, moist	0.115	2	0.057	1.239
Veg	1.932	2	0.966	21.000
Moist	10.878	1	10.878	236.478
Error	15.518	336	0.046	1.000

Table K.21. ANOVA for Sediment Concentration.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	8811819.444	6	1468636.574	0.365
Tramp, veg	42604278.333	6	7100713.056	1.762
Tramp, moist	24538283.056	3	8179427.685	2.030
Tramp	215125794.167	3	71708598.056	17.799
Veg, moist	8810833.889	2	4405416.944	1.093
Veg	52399881.667	2	26199940.833	6.503
Moist	513348366.944	1	513348366.944	127.417
Error	1353703479.999	336	4028879.500	1.000

Table K.22. ANOVA for Electrical Conductivity, Chemical Data.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	114065.017	6	19010.836	0.263
Tramp, veg	2354895.383	6	392482.564	5.430
Tramp, moist	54842.100	3	18280.700	0.253
Tramp	2354718.233	3	784906.078	10.858
Veg, moist	25961.206	2	12980.603	0.180
Veg	243612.706	2	121806.353	1.685
Moist	536540.011	1	536540.011	7.423
Error	24287930.133	336	72285.506	1.000

Table K.23. ANOVA for pH, Chemical Data.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	0.453	6	0.076	0.274
Tramp, veg	3.873	6	0.645	2.324
Tramp, moist	0.458	3	0.153	0.551
Tramp	14.184	3	4.728	17.032
Veg, moist	0.008	2	0.004	0.014
Veg	1.041	2	0.521	1.877
Moist	0.144	1	0.044	0.159
Error	93.270	336	0.278	1.000

Table K.24. ANOVA for Total Alkalinity.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	65.653	6	10.942	0.908
Tramp, veg	90.165	6	15.028	1.247
Tramp, moist	21.651	3	7.217	0.599
Tramp	106.840	3	35.613	2.956
Veg, moist	3.763	2	1.882	0.156
Veg	405.531	2	202.766	16.828
Moist	284.889	1	284.889	23.644
Error	4048.453	336	12.049	1.000

Table K.25. ANOVA for Total Dissolved Solids.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	0.224	6	0.037	0.504
Tramp, veg	2.428	6	0.405	5.520
Tramp, moist	0.070	3	0.023	0.313
Tramp	2.093	3	0.698	9.514
Veg, moist	0.046	2	0.023	0.313
Veg	0.292	2	0.146	1.990
Moist	0.517	1	0.517	7.047
Error	24.651	336	0.073	1.000

Table K.26. ANOVA for Fluoride.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	0.061	6	0.010	0.685
Tramp, veg	0.483	6	0.081	5.550
Tramp, moist	0.053	3	0.018	1.233
Tramp	0.108	3	0.036	2.467
Veg, moist	0.000	2	0.000	0.000
Veg	0.021	2	0.011	0.754
Moist	0.088	1	0.088	6.029
Error	4.904	336	0.015	1.000

Table K.27. ANOVA for Chloride.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	46.982	6	77.830	0.544
Tramp, veg	60.789	6	10.132	0.704
Tramp, moist	43.191	3	14.397	1.000
Tramp	86.875	3	28.958	2.012
Veg, moist	206.082	2	103.041	7.159
Veg	437.328	2	218.664	15.192
Moist	247.175	1	247.175	17.173
Error	4836.182	336	14.393	1.000

Table K.28. ANOVA for Sulfate.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	96988.438	6	16164.740	0.623
Tramp, veg	355060.146	6	59176.691	2.282
Tramp, moist	44648.642	3	14882.881	0.574
Tramp	707792.667	3	235930.889	9.097
Veg, moist	17295.559	2	8647.779	0.333
Veg	81487.651	2	40743.825	1.571
Moist	5126.418	1	55126.418	2.126
Error	8714119.616	336	25934.880	1.000

Table K.29. ANOVA for Sodium.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	43.490	6	7.248	0.349
Tramp, veg	113.485	6	18.914	0.910
Tramp, moist	4.142	3	1.381	0.066
Tramp	212.185	3	70.728	3.404
Veg, moist	70.327	2	35.164	1.692
Veg	1252.230	2	626.115	30.133
Moist	542.481	1	542.481	26.108
Error	6981.421	336	20.778	1.000

Table K.30. ANOVA for Potassium.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	9.401	6	1.567	0.601
Tramp, veg	55.122	6	9.187	3.523
Tramp, moist	7.830	3	2.610	1.001
Tramp	131.037	3	43.679	16.749
Veg, moist	9.098	2	4.549	1.744
Veg	128.022	2	64.011	24.546
Moist	219.492	1	219.492	84.167
Error	876.226	336	2.608	1.000

Table K.31. ANOVA for Calcium.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	249.561	6	41.593	0.056
Tramp, veg	12345.027	6	2057.504	2.793
Tramp, moist	108.292	3	36.097	0.049
Tramp	18536.314	3	6178.771	8.388
Veg, moist	587.301	2	293.651	0.399
Veg	3313.763	2	1656.882	2.249
Moist	4103.596	1	4103.596	5.571
Error	247506.896	336	736.628	1.000

Table K.32. ANOVA for Magnesium.

Source of Variation	Sum of Squares	Degrees of Freedom	Means Square	Test Statistic
Tramp, veg, moist	3.902	6	0.650	0.715
Tramp, veg	15.164	6	2.527	2.781
Tramp, moist	0.841	3	0.280	0.308
Tramp	35.093	3	11.698	12.875
Veg, moist	2.767	2	1.384	1.523
Veg	3.067	2	1.533	1.687
Moist	29.722	1	29.722	32.712
Error	305.289	336	0.909	1.000

(Continued on reverse)

BLM LIBRARY
SC-324A, BLDG. 50
DENVER FEDERAL CENTER
P. O. BOX 25047
DENVER, CO 80225-0047

DATE DUE

GAYLORD			PRINTED IN U.S.A.